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THE SIXTY-FIRST ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE

Issued in accordance with Section 8, Chapter 75, of the General Laws

PART I.—THE REPORT OF THE PRESIDENT AND OTHER OFFICERS OF ADMINISTRATION FOR THE FISCAL YEAR ENDED NOV. 30, 1923

Publication of this Document approved by the Commission on Administration and Finance

DEPARTMENT OF EDUCATION
THE COMMONWEALTH OF MASSACHUSETTS

CONTENTS.

PAYSON SMITH, *Commissioner of Education.*
KENYON L. BUTTERFIELD, *President of Massachusetts Agricultural College.*

MASSACHUSETTS AGRICULTURAL COLLEGE.

REPORT OF THE PRESIDENT.

REVIEW OF THE YEAR.

Resignations and Retirements.

During the year two members of our teaching staff reached the age of seventy and retired as required by State law.

Professor William R. Hart left our service March 31st. He joined the staff in 1907 as Professor and Head of the Department of Agricultural Education. This was the first institution in the country to recognize Agricultural Education as a separate department. Professor Hart soon became recognized as one of the aggressive and sane thinkers in the field of agricultural education. He did more than any other individual in the State to broadcast the idea of Boys' and Girls' Clubs and to organize them for work. Among the four-year students he always stimulated a keen interest in education. Prior to 1907 there were probably less than a dozen M. A. C. men teaching in Massachusetts. Of the graduates of the last sixteen years (1908 to 1923) 122 are teaching in Massachusetts, 108 are in schools or colleges outside of Massachusetts and 35 are engaged in Extension teaching. It has been said of Professor Hart that he "had the clearest vision of the fundamental basis of vocational training of any man engaged in work dealing with the theory of such training. This was openly recognized by many. He held steadfastly to his ideal of what his department should be and never wavered under the most discouraging circumstances."

Professor W. S. Welles, who joined our staff in 1919, has been made Head of the Department of Agricultural Education. Professor Harry N. Glick has been brought into the Department to fill the vacancy caused by Professor Hart's retirement. Professor Glick was raised on an Illinois farm and has had wide experience in educational work; he has taught school many years and has pursued graduate study in education at the University of Illinois.

Dr. Charles Wellington retired May 4th. A graduate of the class of 1873, he returned to teach in the Department of Chemistry in 1885. From 1882 to 1885 he studied in Germany, receiving the Degree of Doctor of Philosophy at the University of Göttingen in 1885. He was one of the first chemists trained by the late Dr. Goessmann of whom Dr. Wellington was a loyal disciple. Dr. Wellington gave 38 years of faithful service to the College, during which time he won the respect and love of a host of M. A. C. men.

Arthur N. Julian, who has been teaching German since 1912 and who has been studying Chemistry for three or four years, has been transferred to the Department of Chemistry as Assistant Professor, to fill the vacancy caused by the retirement of Dr. Wellington.

On August 31, Professor S. M. Salisbury resigned as Professor and Head of the Department of Animal Husbandry. Professor Salisbury joined our staff in 1919 and has maintained the high standing of this department established by Professor McNutt and Professor McLean. Professor Salisbury left to accept a position in the Extension Service of the College of Agriculture at the Ohio State University.

Near the close of the fiscal year, Harold F. Tompson, Professor and Head of the Department of Vegetable Gardening, resigned in order to devote his at-

tention to the supervision of his market gardening farm at Seekonk, Mass. Professor Tompson graduated from the Massachusetts Agricultural College in 1905; served as instructor in market gardening here for two and one-half years, and after further experience in teaching and in practical work, in 1914, was called back as Head of the Department. In addition to directing the resident teaching in Vegetable Gardening, he had charge of the Market Garden Field Station at East Lexington; he assisted in the selection of the site and planned the program for the demonstration work there. He has been eminently successful in meeting the needs of the market gardening industry as they have been developed in the vicinity of Boston and his service has been uniformly approved by the market gardeners.

In September, Professor James A. Foord resigned as Head of the Division of Agriculture and will, as soon as his successor is appointed, devote his entire time to the Department of Farm Management. Professor Foord has been Head of the Division of Agriculture since 1907, during which time, from a small department, the Division, as it is now organized, has been built up, both with respect to personnel and to buildings. During this time Professor Foord has had charge of the details of this large development in which he has rendered a most conscientious and highly painstaking service.

On August 25, 1923, Newton Wallace, who from 1896 to 1917 had charge of the power plant and served as electrician and engineer of the College, died at Huntington, Mass. For many years he was a conspicuous figure on the campus and to him is due the credit for the early development of the central heating plant, laying out of steam, water and sewer mains, and other problems connected with the supplying of light and power for the various buildings.

Improvements and New Construction.

The Legislature of 1923, as was contemplated in 1922, made an appropriation of $150,000 for the completion of the Chemistry Laboratory. Owing to labor and other difficulties, work on this building has progressed very slowly. It is doubtful whether the building will be completely ready for occupancy before the summer of 1924.

The appropriation of $10,500 for roads and walks has been used on "The Olmsted Road" in constructing a road with stone base and asphalt surface, from the entrance to the campus at Pleasant Street, extending a distance of 1300 feet; and for the construction of a cement sidewalk parallel with this road. For obvious reasons it seemed desirable to locate the new walk north of the row of trees, extending along this road; this made necessary the extension of the bridge across the stream. The result is entirely satisfactory and commends itself to all interested. The Division of Highways of the State Department of Public Works supervised the construction of this road; this arrangement insured us the maximum of efficiency and economy.

The other special appropriations of 1923 for live-stock, for additional buildings at the Tillson Farm, for service buildings for the Division of Horticulture and for a farmhouse to replace the one destroyed by fire in December 1922, have been expended for the purposes specified.

Commencement.

Owing to a feeling on the part of students that they were placed at a disadvantage in securing summer work by the late Commencement scheduled for 1923, the Trustees voted to dispense with the spring vacation, cut down the length of the spring term to eleven weeks and close the institution for the summer vacation June 11. Accordingly, the usual commencement exercises were held from Friday to Monday, June 8 to 11. The commencement address on June 11 was delivered by Honorable W. N. Ferris, United States Senator from Michigan. The degree of B. Sc. was conferred upon 82 men and 7 women; the degree of M. Agr. upon 2 men; the degree of M. Sc. upon 8 men and 1 woman and the degree of Ph. D. upon one man.

Enrollment of Students.

In Courses of Collegiate Grade. — It was pointed out in the report of a year ago that the attendance of students at the Agricultural Colleges had steadily declined during the past few years. The Massachusetts Agricultural College has maintained its enrollment better than the majority of similar institutions, although this year, there is a slight falling off in total attendance; the total is 431 exclusive of the Graduate School as compared with 470 in 1922. The enrollment in the entering class is 125 or approximately two-thirds that of a year ago. The cause for the reduction in attendance, in this and other similar institutions, has not been satisfactorily explained. Probably the feeling that the food producers of the country are receiving an inadequate return for their service is reflecting itself in the minds of those who would otherwise attend an agricultural college for the purpose of preparing themselves for some agricultural occupation. Statistics have been compiled from approximately half the agricultural colleges of the country showing their comparative enrollment of freshman students in 1922 and 1923. Of the twenty-six institutions reporting, seven show a gain in Freshman registration in 1923 over 1922; the total gain of these seven institutions is 50. Nineteen institutions report a decrease in enrollment and the total loss in these nineteen institutions is 461.

In the Two-Year Course. — There is a marked decrease in the enrollment of two-year students. In 1920 the enrollment was 277; in 1921, 293; in 1922, 257 and in 1923, 169. This decrease is due in part to the withdrawal from this institution of a number of Federal Board students who have either finished their training or who have been transferred to other institutions established primarily for the rehabilitation of service men. The analysis of attendance in all courses is found on page 25.

Students entering the Freshman Class in 1923.

Of the Freshmen entering this autumn, slightly over 95% are from Massachusetts. Apparently the requirement of an annual tuition of $180 for students from states other than Massachusetts has very effectively cut off the attendance from other states. Formerly 10% to 15% of each Freshman class came from other states. I should like to ask whether this tendency, brought about by the increase in tuition, is wholly desirable? Ought there not to be encouraged a normal exchange of students between the Agricultural Colleges? At present more Massachusetts boys are being educated in state institutions outside of Massachusetts than the total of non-resident students at the Massachusetts Agricultural College.

The opinion has been frequently expressed that students do not come to the Massachusetts Agricultural College because of their interest in agriculture. A special inquiry was made of students entering this autumn, to ascertain why they came to the Massachusetts Agricultural College. 67% stated that they came because of their interest in agriculture; 25% stated that they came because they desired a general education, either with or without respect to agriculture; 5% came with the idea of transferring to other institutions at the end of one or two years, and 3% came because of other considerations.

Research Work in Forestry.

In June an agreement was entered into with the United States Forest Service providing for the location at this institution of a Forest Experiment Station for the Northeastern area. The College, by the agreement, obligates itself to supply quarters, including office space and laboratory facilities, heat, light and janitor service for the staff which will be placed here. At the outset this staff will include approximately five foresters, one pathologist, two entomologists and two clerks. The staff of foresters is being accommodated in French Hall. As the Pathologist and Entomologists are added, they will be housed respectively in Clark Hall and Fernald Hall. There has been some delay in the staff coming to Amherst and at present not all are here. The work, however, is well under way.

This co-operative arrangement will cost the institution practically nothing and will bring to it the prestige attendant upon the location of such an Experiment Station, and will greatly strengthen the teaching work in Forestry.

Excursions to the College.

During the past few years groups of people from various parts of the State have been coming to the College in greater numbers. Some of these groups attend formal programs such as Farmers' Week or High School Day, while others come for less definite objectives but all for the purpose of inspecting the institution with more or less thoroughness. To illustrate the extent to which these excursions are now being made to the College, the following list is given, covering the fiscal year just closing.

December 19–22, 1922, Conference of County Agents, Attendance, 50.
January 1–Feb. 21, 1923, Series of 10-day Dairy Courses, 24.
January 19–20, Alumni Day, 115; Polish Farmers' Day, 100.
March 11, Sheep Shearers' Day, 75.
May 4, Massachusetts Legislature, 225.
May 5, High School Day, 750.
May 12, Phi Sigma Kappa — 50th anniversary, 100.
May 12, Western Massachusetts Headmasters Club, 25.
May 16, Mass. Veterinary Medical Association, 50.
May 16, N. E. Ice Cream Manufacturers Assn., 35.
May 19, Parents' Day (Women Students), 21.
May 26, Western Massachusetts Grammar Masters Club, 25.
June 14, Executive Committee Mass. State Grange, 3.
June 15, Directors of Mass. State Chamber of Commerce, 25.
June 27–29, Agricultural Instructors, Connecticut, 19; Boys' Farm Camp in Sunderland, 30.
June 23–30, One Week School for Florists, 11.
July 9–13, Country Clergymen's Course, 32.
July 17, Middlesex County Club Workers, 75; Boys' Camp, 40; Camp Gilbert, 100.
July 31–Aug. 3, Conference of Teachers of Agriculture, 70.
July 24–27, Farmers' Week, 2,500.
August 1, Hampden County Club Members, 200.
August 10, Connecticut Pomological Society, 80.
August 11, Hampshire–Franklin Holstein–Fresian Breeders Club, 60.
August 14, Permanent Firemen's Association, 110.
August 18, Agricultural Teachers, Cornell Univ., 14.
August 21–24, New England Grange Lecturers' Conference, 750.
August 31, Hampshire–Hampden Forestry Conference, 25.
September 10, Camp Vail Club Leaders Training School, 15.
September 17–21, Western Massachusetts Library Club, 80.
October 5, Executive Comm. Associated Industries of Massachusetts, 40.
October 12, Mt. Toby Day, 100.[1]
October 18, Governor's Council, 8.
October 18, Excursion from Springfield, National Council of Congregational Churches, 800.
October 20, Athol Boys and Girls Clubs, 45.
October, Delegation from Argentine to World's Dairy Congress, 4.
November 22–23, Advisory Board State Department of Agriculture, 3.

Visit of the Legislature.

The most important visit to the College during the year was that of the Massachusetts Legislature. Just prior to the opening of the last session, Senator Haigis of Greenfield visited the College, and at that time asked whether we would welcome a visit from the Legislature. Early in the session he introduced an order providing for the inspection. The order was passed on April 11, and the

[1] Visitors.

day set for the visit was Friday, May 4. The legislative session was adjourned in order to allow all members to make the trip to Amherst. A special train composed of steel coaches, left North Station at 8:30 A.M. and arrived at Amherst at 11:40. Here the guests were met by eighty automobiles, placed at our disposal by citizens of Amherst and by alumni in nearby towns. Each automobile was accompanied by a guide who was a member of the staff, an alumnus, a Trustee, or a student. A general tour of the campus was made, thus giving the visitors a comprehensive view of the equipment and extent of the physical plant. This tour of inspection occupied about fifty minutes and was followed by luncheon at the Dining-Hall. Immediately after luncheon the Legislature adjourned to Bowker Auditorium where the platform had been extended to accommodate all the guests. The students assembled early and were in their seats when the Legislature proceeded to the platform. The gallery was well filled with members of the Faculty and townspeople.

Honorable Charles A. Gleason, Vice President of the Board of Trustees, presided. A brief address of welcome was made by President Butterfield, to which responses were made by Honorable Frank G. Allen, President of the Senate, and Honorable B. Loring Young, Speaker of the House of Representatives. From 2:30 to 4:00 P.M. each automobile party, still accompanied by a guide, visited from four to six departments of the institution where some form of classwork was in operation. This plan made it possible for every department to be visited for a sufficient length of time to fully acquaint the members of the Legislature with the research and teaching work carried on. At 4:00 the guests assembled on the Cavalry Riding Field south of the Veterinary Laboratory where bleachers had been provided. Here a parade of the live-stock was held, each animal presented having been fitted for the show by a student. Professor Salisbury, with a megaphone, explained the breed and record of each animal and also gave the name of the student accompanying it.

The last event of the day was a cavalry drill on the riding field. At 5:00 P.M. the special train left Amherst for Boston.

This is the only time since February 1868, that the entire legislature has visited the Agricultural College. 200 out of 280 members were present. Very few of these men had ever visited the College before and practically all expressed surprise at the size of the institution and many voiced their approval of the type of work carried on.

The visit was a significant occasion for the College and one which the officers had long hoped would be brought about. Because so little was known about the College, its interests have been frequently neglected.

To Senator Haigis belongs the credit for initiating the idea of this project and for bearing the responsibility for seeing it through the Legislature. However, many Alumni and friends of the College throughout the State, as soon as they learned that this plan was being considered, used their influence in persuading members of the Legislature that such a trip would be of value to them as well as to the Institution. A number of alumni accompanied the Legislature to Amherst and assisted in entertaining them. Citizens of Amherst contributed generously of their time as well as of their automobiles, in taking the Legislature about the Campus. The students extended a most enthusiastic welcome and provided a box-lunch for the members on the train back to Boston.

The direct expense to the State from College funds was nominal. The Legislature paid for the special train. The automobile service was generously donated. The luncheon and souvenir booklets were paid for from a private fund.

Boys' Camp.

For several years before the war and one year since the war, a Boys' Camp was conducted on our Campus. In previous years the expense to the institution had been rather more than was thought to be justified. However, there has always been considerable demand for a camp of this kind and the interest shown in it by those attending has always been of the best. In 1923, therefore, it was decided to organize a camp on a somewhat different financial basis than previously. Mr. Mellen, Field Agent of the College, who has had ample experience

in Boy Scout work, assumed responsibility for organizing and supervising the camp. The camp opened June 30 and closed July 28. The average registration per week was 25 and the total number of boys was 40. The boys were charged $10 per week, which covered their board, supervision and incidental expenses. On this basis the camp, from its operating expenses, returned a slight balance to the State Treasury. The College, however, had provided the publicity, the general supervision given by Mr. Mellen, and the tents. With the larger enrollment which is possible without greatly increasing the overhead expense it is probable that the income would exceed the operating expenses sufficiently to offset the time cost of supervision and the publicity.

The camp is designed to appeal to country boys who cannot afford to patronize the more expensive private camps and also to city boys who have an interest in agriculture and outdoor life. The daily camp program includes instruction in agriculture as well as recreation.

The camp this year was well organized and was well supervised and probably, if it is continued, will receive adequate support.

Mountain Day.

On October 12, 1923, there was revived a tradition which has lapsed for many years, namely, that of Mountain Day. This year an outing was planned on Mount Toby where in co-operation with the State Department of Conservation, a 60-foot steel tower has recently been erected. Friends of the College from surrounding towns were invited to join the students and faculty on this outing. It is estimated that about 800 were present. Following the luncheon at the summit at 12 o'clock, there was a brief program of speaking by President Butterfield and Honorable W. A. L. Bazeley, and a pageant written by Professor Frank P. Rand of our English Department was acted by students and members of the staff.

This affair so thoroughly commended itself to the students and faculty that it is expected to become an annual event.

Recommendations for Legislation.

Two Amendments to existing laws are recommended by the Trustees.

1. Feed Law.

Be it enacted, etc.

That section two hundred and twenty-seven of chapter ninety-four of the General Laws of the commonwealth, as amended by act of legislature in chapter four hundred, nineteen hundred and twenty-two, be changed by omitting the word "twenty" from line nine and substituting therefor the word "fifteen", so as to cause this line to read, "Pay to said director or his authorized deputy a registration fee of fifteen dollars."

The purpose of this Amendment is to reduce from twenty dollars to fifteen dollars the brand fee charged for the collection and analysis of commercial feed stuffs. The reason for recommending the change is that the present tax is higher than is justified by the work done. The appropriation for this work for 1923 was $9,000. The appropriation request for 1924 is $9,500. The income from the brand tax in 1923 was $19,420.

2. Publications.

Proposed Amendment to Section 9, Chapter 7, of the General Laws of Massachusetts.

The above section should be changed to read as follows:

"This section shall not apply to publications issued by the officers of either branch of the general court, or issued under special authority given by the general court, or to the regular annual reports of the attorney general, state treasurer, or state secretary, or to publications reporting results of research work conducted by the Department of Education through the Massachusetts

Agricultural Experiment Station, or to reports of capital trials prepared by the attorney general under Section 11 of Chapter 12, or to publications prepared by the state secretary in conformity with Sections 2 and 4 of Chapter 5".

This in effect adds the research publications of the Massachusetts Agricultural Experiment Station to the list of exceptions previously recognized. This is necessary in order that the effectiveness of the Experiment Station as a research institution may be maintained. An essential requisite in the work of any research institution is certainty of publication without fear or favor, and in such a way as to make the author or the research worker fully responsible for the character, accuracy and efficiency with which the work is done. Any method of state control which prevents publication, or which through its editorial policy may prevent effective publication, may vitiate the results of the work, and make unproductive the expenditures of time and money, for such work. For all of these reasons, therefore, an exception to the general ruling should be made in favor of the Agricultural Experiment Station. This exception, however, should not be considered to include those publications of the Experiment Station which are other than *bona fide* reports of actual research work.

Occupations of Graduates.

The occupations of the graduates of our four-year course is still a subject of considerable discussion among those interested in the college. On the basis of returns received within a year, an analysis has been made of the occupations of alumni for the past twenty years, namely the classes of 1903 to 1922, and from this analysis the following statistics are compiled:

Occupational Classifications of Graduates based on Statistics collected 1923.

Classes 1903 to 1922, inclusive.

	Number.	Per Cent.
Living graduates whose occupations are known	1,190	
Agricultural Vocations		
Farm Operators, including market gardeners	251	21.09
Landscape gardeners, foresters and florists	96	8.07
Agricultural College administrators and teachers	79	6.64
Agricultural school administrators and teachers	60	5.00
Experiment Station administrators and experts	27	2.27
Extension Service administrators and experts	37	3.11
State agricultural experts	32	2.69
U. S. D. A. administrators and experts	53	4.45
Agricultural business	69	5.80
Miscellaneous agricultural experts	59	4.95
Total	763	64.12
Non-agricultural vocations		
Business	211	17.73
Engineers	46	3.86
Physicians	18	1.51
Teachers	93	7.81
Miscellaneous	59	4.95
Total	427	35.88
Unknown occupations	97	

IMMEDIATE PROBLEMS.

The Question of Expansion and Support.

The Present Budget. — For some years it has been the policy of the State Administration to discourage expansion in our work. We have realized the need of economy and as a consequence have not pressed for large developments. In the present budget, for example, we are not asking for major buildings,

much as we need them; but we do wish to secure special appropriations sufficient to enable us to carry out a number of comparatively small projects for equipment, some of which have been repeatedly requested by departments for periods ranging from two to six or eight years. We are seeking only a slight increase in the budget for maintenance of instruction. In our Extension Service we should have a few new positions on the staff to permit us to meet demands that are coming to be very pressing and that will round out the scope of our service for the period of the next few years at least. It is an unfortunate fact that the Extension Service has been getting progressively smaller sums for maintenance for several years past. The assumption at the State House seems to be the fallacious one that the work of the County Extension Service will gradually make unnecessary the work of the State Extension Service. A really serious phase, however, of our failure to expand lies in the field of the Experiment Station. True, last year three or four new staff positions were granted; but there should be established at least ten more new positions in the immediate future. There is no need to argue with you the importance of investigational work; but I do desire to stress the necessity of early and substantial increases in our equipment for research. We are not keeping up with the demands of the situation.

The Food Supply Campaign. — Some years ago, we at the College began to think rather seriously of the fact that it was becoming more and more difficult to advise the farmers of Massachusetts with respect to their long-term policies, until we know more about the market for their products — that is to say, until we knew more about what the food consumers of the State require and where they get it. We discovered that certainly not more than 15% and possibly not more than 10% of the food consumed in the State was grown in the State. We were obliged to ask ourselves, "To what extent and in what lines of agricultural endeavor is it probable that the farmers of Massachusetts con compete with farmers in other parts of the country and of the world?" Thus we were led inevitably toward the consideration of such questions as marketing, transportation, and storage. But we could not stop even there. Problems of waste induced us to consider food conservation. Finally we perceived that we must understand human nutrition and the dietaries of consumers. And then we found that so closely inter-related were all of these matters that we had virtually one unified problem — the problem of the Massachusetts Food Supply. And we said to ourselves "Here is *our* task. We are convinced that we cannot do the best for the farmers unless we compass the entire problem. Moreover, here is something, growing out of the agricultural character of our college enterprise, that concerns every person in the Commonwealth."

The full realization of this enlarged conception of our work probably came during the war. As far back as in my report of 1917 I outlined the problem of food supply, stating, at the time, that this now seemed to be our field. Some three years ago you authorized me to proceed to try to interest various groups of citizens in the larger function of the College. It seemed wise to try to make clear to these groups that the College is the concern of all people of the State; that its field includes the food supply problem; and that this problem is one of the major economic questions of our time. My absence in China prevented an earlier carrying out of your authorization, but during the past year we have definitely been in touch with the Grange, with the State Chamber of Commerce and many city Chambers of Commerce, with The Associated Industries, with representatives of organized labor, with the State Federation of Women's Clubs, and with many Rotary and Kiwanis and similar business men's clubs. We have lectured before these groups on the food supply problem and the relation of the College to it. We are now preparing literature for distribution by these organizations. We have had visits to the College from the official executive bodies of most of these groups, and under your authorization a bill has been drawn providing for an unpaid Commission on Food Supply, whose duty it shall be to begin at least a study of the food supply of Massachusetts in all its various aspects.

All this procedure is most significant with respect to the purpose, work, and development of the College. It is frankly an enlargement of scope, but one wholly germane to the agricultural character of the institution. It will eventually mean a substantial increase in work and equipment. The food supply problem will doubtless call for prolonged research. Very soon will come a demand for trained specialists in marketing and other similar phases of the work. We will be required through our Extension Service to assist in reaching every home in the Commonwealth. In my judgment, all of our agricultural colleges will in time attempt to cover this entire field; at present we are the pioneers. I hope that the people of the Commonwealth, who are now undoubtedly becoming aroused to the significance of the food supply question and the need of educational work and especially of investigation with respect to it, will permit us to assist in its solution, as we can if we are given the facilities of equipment and staff.

Expansion in Educational Scope of the College. — When the Commission on Higher Education visited the College about a year ago, we laid before them three suggestions to which we hoped they would agree, as representing the relation of this institution to the system of higher education in the Commonwealth: (1) that nothing should be done now or later to restrict our work as a College of Agriculture; (2) that we should be definitely allowed to expand our work to include the whole field of food supply — production, conservation, market distribution, and food utilization — and with respect also to our full service in the three phases of work that we are obligated to perform, namely, investigation, the training of specialists, and extension teaching; (3) that if it seemed wise to utilize our equipment for service beyond these two fields, the courses to be developed should grow out of other applications of those natural and social sciences which we must have as a basis for agriculture, country life, and food supply. This statement we considered "official" in the sense that it pretty clearly represented faculty opinion, and we had reason to think also the views of your Board of Trustees.

In addition to these suggestions, various members of the faculty handed to the Commission memoranda expressive of individual views. Personally I have some convictions concerning this whole problem of higher education in the State, but doubt whether this report is the place for publishing them. Moreover, at this writing the report of the Commission has not been made public and I do not wish to anticipate that report. I feel, however, quite keenly that the time has come when our College should be allowed to broaden the scope of its work somewhat beyond the fields of agriculture, country life, and food supply, and on the principle enunciated in our suggestions to the Commission. I have arrived at this conclusion with much personal reluctance because, as you know, I have always maintained that this College should be nothing but an agricultural college. But I think it is evident that the State will be asked to provide increasing facilities in higher education, and whatever plan is followed in this development there is no avoiding the conclusion that the Massachusetts Agricultural College should be fully realized in that plan.

I should like to call attention to a sentence in the Morrill Act of 1862, which is virtually the charter of our College as it is of every other similar institution in the United States. That part of the Act which describes the purpose of the institution, is as follows:

"The leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

As a rule, that part of this statement of purpose usually emphasized is the first part, and seldom have we discussed the full meaning of the words "the education of the industrial classes in the several pursuits and professions of life". But *the whole contention of the advocates of enlarged facilities in higher*

education in Massachusetts today is based largely on the plea that the boys and girls from the homes of the industrial classes are not getting their chance. Here is our charter, at our very hand, authorizing us to enlarge our scope, in order that the sons and daughters of the industrial classes of this great industrial Commonwealth may have a fuller chance for such higher education as they are capable of and for any occupation that they want to enter.

New Courses. — I wish to recommend that steps be taken to secure whatever permission may be necessary from the legislature to enable us to start three new courses, if possible the coming autumn.

(1) *A Course in General Science.* — We have many students already with us, and there are many more high school students who do not come to us because we do not offer this course as yet, who are uncertain as to the particular occupation they would like to pursue, but who wish to secure a rather general education which will be largely composed of work in science, rather than in language and literature, and which will form an adequate foundation for the pursuit of vocations connected with the industries and business dominant in Massachusetts. We could easily formulate a general science course with subjects already offered. Any additional costs involved would for the present be almost wholly due to an increased number of students.

(2) *A Teachers' Course.* — We already have a strong department of agricultural education, which with the addition of possibly one or not to exceed two instructors, could care for some while for the pedagogical work necessary to train high school teachers of science, both men and women. There is a large field here which we have entered very slightly because of our previous emphasis upon the agricultural aspect of education. This course should also include the training of high school directors of athletics and physical education.

(3) *A Course in Home-making.* — Here again we have nearly all the material already at hand, though we should need soon two or possibly three more instructors, because thus far we have not been allowed to develop our home-economics work on a four-year basis. I should like to make it clear that we need not feel compelled to offer a highly specialized course in home-economics except as future demands may come, but rather a general course for women in which the home-making elements shall receive adequate attention. There is no reason why women should not continue to take work in agriculture and in science. Many will undoubtedly elect the proposed new courses in general science and for teachers; others, and I think the majority, will eventually wish to follow a specially organized course for women in which home-making will play a significant part.

All three of these proposed courses follow the principle already indicated, namely, that we would utilize existing offerings in the course of study and thus reduce added institutional costs to very slight terms. In other words, with a minimum increase in our "over-head" we can develop some very important opportunities for the youth of Massachusetts. It is true that if these new courses should attract students in large numbers the cost of maintaining the institution would increase, but there would be small increase due to the mere fact of multiplying courses. In no other way, so far as I can see, can the State so economically provide new opportunities for its youth along certain lines.

Moreover, these new courses are in harmony with what in my judgment should be the fundamental principle of our expansion, namely, the development and maintenance of the *liberalized occupational course* — a course that frankly prepares for occupation, and yet which recognizes that occupational preparation is by no means wholly a matter of technical knowledge, and cannot fairly exclude suitable training for citizenship and for individual mental and moral development. At first thought it may seem as if the proposed course in general science would not fall in with this principle; but I think this course should be very definitely foundation work for occupation, although the student need not specialize in any single occupation while following undergraduate studies.

THE RELATION OF THE COLLEGE TO THE STATE ADMINISTRATION.

During the past year we have been in frequent contact with the new Commission on Administration and Finance. All of our requests have received consideration and the members of our staff have been given courteous personal treatment. We are not, however, reconciled to the essential unsoundness of the present scheme of centralized control of expenditures. Several decisions of the Commission this year have been particularly trying. Three bulletins of the Experiment Station have been refused publication. As you are aware, you have already authorized the preparation of a bill intended to exempt the State Experiment Station from the provisions of the law that gives the Commission on Administration and Finance control of publications. We have had also, in recent months, an unpleasant illustration of the way in which the Commission can control fundamental policies. A vacancy in the office of Nutrition Specialist in the Extension Service, which we asked to be filled early in September, has not been filled because the Commission at first questioned the policy of our continuing the work so long as the State Department of Health also had a nutrition worker. Our Nutrition Specialist was an office established a number of years ago, under a joint agreement with the United States Department of Agriculture and does work practically required under the Smith-Lever Act of Congress, which the legislature of this Commonwealth accepted. On general principles, furthermore, if there be real duplication of work, no administrative agency in the Commonwealth should be permitted to do educational work that in the very nature of the case belongs to the College. A further ruling of the Commission apparently indicated their willingness to allow the position to stand but materially reduced the salary. We appealed to the Governor and Council and the matter is still pending.

Now, Gentlemen of the Trustees, this sort of procedure simply cannot go on if you desire to maintain the morale of the staff and if you expect the institution to do its work economically and efficiently. I do not like to continue to protest against the present methods, as I have done every year since the system was established. Because of the fact that we are still maintaining our work and that we have lost comparatively few from our staff, it may seem to you that we are becoming reconciled to the law and the administrative rulings and that the issue is not serious. On the contrary, it is most serious. I cannot exaggerate its seriousness. I assure you that many of us who come into closest contact with these administrative relationships have reached nearly the limit of our endurance.

The essence of the reform we desire is that you as a Board of Trustees shall have your power of control of the College restored to you, that it shall be specifically recognized that neither the Commissioner of Education nor the Commission on Administration and Finance shall have more than advisory and recommendatory powers. We concede the value of the State Budget system, though in our judgment the number of classified items in our part of the Budget should be greatly reduced, if indeed the one item for the College may not suffice. We think the law should be changed to permit the Trustees to decide upon the extent to which members of the staff may travel outside of the State at State expense, and a law enacted which will permit the earnings of the institution to be at once reappropriated for its use. We believe that the Trustees should have full power to decide the scope of our work; the type of expenditures that are justifiable; to employ members of the staff and to fix their salaries. We believe that this power should be final and not subject to veto on the part of any of the other State officials.

There is no question but all these powers should be held by the Trustees subject to legislative authority and to such checks, accounting, and reviews as may be demanded by sound public policy.

MASSACHUSETTS AGRICULTURAL COLLEGE LEGISLATIVE BUDGET 1924.

Projects for Permanent Improvement.

1. Tunnel for Steam Line from Power Plant to Stockbridge Hall, $39,000.

The principal argument advanced in support of this project is the recommendation made by French and Hubbard, engineers, who recently made a study of the present heating plan and future development for the same, "that a tunnel be constructed to Flint Laboratory and Stockbridge Hall and the piping arranged so that exhaust steam can be used in these buildings. We are firm believers in tunnels for steam mains of this kind, and believe that when it is necessary to rearrange the underground piping, tunnels should be constructed. We would recommend this both for economy in the long run and on account of convenience in repairs and pipe insulation."

At present none of the underground steam lines are enclosed in tunnels. The result is a high cost of maintenance because of the excessive radiation and because of the difficulty in locating and repairing leaks. Also, at present, the maximum use is not made of exhaust steam; this latter difficulty would be met by the project here outlined.

2. Horticultural Manufactures Laboratory and Equipment, $60,000.

The importance of utilizing various by-products of the farm which formerly were wasted, such as fruit and vegetables, was emphasized during the war, and under the direction of Prof. W. W. Chenoweth of this institution farmers came to see whereby this saving could to advantage be made permanent. In order to give adequate instruction in the preservation of fruit and vegetable products, a new laboratory building is essential. The plans provide for a one-story building of inexpensive construction, which will furnish laboratories for the various phases of this work.

The pressing need for this building is now generally understood. However, some of the principal considerations may be recapitulated as follows:

(*a*) The department of horticultural manufactures now has its work widely distributed in four buildings, viz. Flint Laboratory, Wilder Hall, French Hall, and a workshop on the hill near the cold storage plant. This wide scattering of the work is obviously very detrimental to its objective.

(*b*) The principal teaching is done at Flint Laboratory in rooms which were designed for the use of the dairy department. The dairy department needs these rooms and would like to see the department of horticultural manufactures cared for elsewhere as soon as possible.

(*c*) The present quarters are entirely inadequate for the teaching work. On account of the limited space the department has been compelled to refuse admission to numbers of students. This is perhaps the only department in the institution which has been compelled frequently to refuse admission to students on account of lack of space. All the teaching could be much better organized and more efficiently conducted in a new building designed for this particular work.

(*d*) It is highly desirable that vigorous research work be undertaken at the earliest opportunity in the field of fruit and vegetable preservation and the manufacture of by-products. A strong demand exists for this work among fruit growers, but the subject is equally important to all consumers of food in Massachusetts.

(*e*) The department is now carrying on important extension work, but these extension projects need to be strongly supported by effective work at the college, and especially by well-directed research work.

(*f*) The Massachusetts Fruit Growers' Exchange Association, the Boston Market Gardeners' Association and other organizations have urgently requested this proposed building. This demand from the fruit growers and vegetable growers should be squarely met.

3. Miscellaneous Buildings and Improvements in Accordance with Schedule below, $34,650.

(*a*) *Tobacco Barn, Brooks Farm, $5,000.* — One of the experimental projects to which attention has recently been given is that of cultural problems of tobacco. A section of the farm is used for growing tobacco and a barn for drying tobacco is necessary.

(*b*) *Tillson Farm: House for Foreman, Shop and Storage, $5,500.* — These additional improvements at the Tillson Farm are necessary to more adequately conduct the experimental work in Poultry Husbandry carried on there.

(*c*) *Buildings at the Farm: Calf Barn, Piggery, Storage and Granary, $10,000.* — These minor buildings are requested in order to provide much needed facilities on the College Farm.

(*d*) *Head House for Agronomy Greenhouse, $2,650.* — This appropriation is requested in order to supplement the laboratory facilities in connection with instruction in soils and crops.

(*e*) *Culvert over Brook in Ravine for Coal Storage, $2,500.* — With the prospect of the winter coal supply for the College being delivered before the first of December, it is necessary that the space for storing coal be enlarged. By building a culvert over the brook, which runs near the present coal storage it will be possible to store the amount of coal necessary during the portion of the winter months.

(*f*) *Land for Cranberry Station at Wareham, $1,000.* — This appropriation is requested for the purchase of about sixteen acres of land contiguous to the cranberry Station at East Wareham, for the purpose of providing an opportunity for an increase in experimental work with blueberries, for variety testing of cranberries, and other experimental work of a similar nature. A part of this sixteen acres is adjacent to a pond, and is a favorable site for the construction of a second experimental bog. Another part is well suited to the extension of the commercial blueberry work, while the remaining area is needed both for straightening the boundary of the present plant and to serve as a source of upland peat, sand, and fuel.

(*g*) *Storage for Winter Vegetables, $3,000.* — In order to demonstrate the advantages to be derived from community storage for winter vegetables it is proposed to erect on the grounds of the college, a building which will not only store the vegetables produced at the college but also serve as a demonstration to communities interested in a similar project.

(*h*) *Fencing Fruit Plantation, $3,000.* — Because of lack of funds, the fencing of the large fruit plantations owned by the college has been deferred. As a result, a good deal of fruit is stolen each year in spite of the fact that the orchards are protected by a watchman during the season when the fruit is ripening. The expenditure of the sum here indicated would seem to be justified on the grounds of economy.

(*i*) *Vault, Basement of Library, $2,000.* — While it does not seem advisable to request at this time, any large appropriation for Library improvements or for the construction of a new building, it is important that a small fireproof vault be provided in the basement of the present building in which may be stored certain historical records and memorabilia of the College, many of which are of large value.

4. Addition to Rural Engineering Building, One Unit, and Equipment, $17,500.

The demand for instruction in Rural Engineering has greatly increased during the past four years. The Two-Year students in particular elect this work in large numbers. In view of the fact that such a large proportion of the instruction is given in laboratories, it is essential that in the interest of economy as well as convenience larger laboratory facilities be provided. In the opinion of the head of the department, the present laboratory and shop should be double in size; the appropriation here indicated would provide for an increase of 50% in the floor space of the existing facilities. This additional space would be used for instruction in the care of motors, farm machinery, and in the making of concrete, and for the display of farm machinery and other equipment.

5. Roads and Walks, $10,000.

The College is responsible for the up-keep of approximately two miles of road running through its grounds, a road which is used constantly by the public. In 1923 approximately 1,700 feet of this road were rebuilt by an appropriation granted by the legislature of 1923 and under the supervision of the State Department of Public Works. An appropriation of $2,500 has also been used for the rebuilding of a portion of the main walk at the entrance of the campus.

Prior to the outlay of 1923, practically no money has been spent for either roads or walks for many years. It is desirable that the main roads and walks be rebuilt as rapidly as possible. In order to make progress in the carrying out of this plan, an appropriation of $10,000 is requested for 1924, for the extension of the work already appropriated in rebuilding the present roads and walks on the campus.

6. Buildings for Market Garden Field Station at Waltham, $25,000.

The trustees of the will of the late Cornelia Warren have deeded to the College about fifty acres of land located near the Clematis Brook railroad station in Waltham. This area is admirably suited for experimental work with vegetable crops. There are about twenty-three acres of level, uniform, well-drained, upland soil naturally much better adapted for experimental purposes than is the present area at North Lexington; and about fifteen acres of peaty, swamp deposit, typical in many respects of the area of wet land now being reclaimed in many different parts of the State, primarily as a health measure, but potentially of great importance to agriculture.

In addition, there is a farmhouse, which may be remodeled to serve as living quarters for the Field Station foreman, and likewise as administrative headquarters for the plant. There are a number of other smaller buildings, some of which can be utilized, others of which may have to be wrecked.

The opportunity for more thoroughgoing investigational and demonstrational work in vegetable growing is so apparent that the trustees of the college have gladly accepted this gift. The sum of $25,000 is needed to cover the cost of the initial equipment at the new Field Station, in order that work may be started in the late fall of 1924. This appropriation is needed to erect a thief-proof wire fence around the plant, to care for the remodeling and moving of one of the smaller buildings now on the place to serve as service headquarters; to build a greenhouse range and heating plant; and to make preliminary repairs on the house and other buildings. In addition, small appropriations will later be needed to care for the draining of the swamp and to make other improvements.

It is expected that receipts from the sale of the North Lexington property will be approximately $20,000. In effect, therefore, the initial cost to the State of the much larger plant at Waltham, a total of fifty acres as against twelve acres, with increased opportunity for effective work, will be approximately $5,000.

Kenyon L. Butterfield,
President.

ANNUAL REPORT OF THE ACTING DEAN FOR YEAR ENDING 1923.

The college year 1922–23 opened very auspiciously. The entering class numbering 187 was the largest since the war and from the standpoint of scholarship and general attitude proved to be one of the most satisfactory that ever entered the college.

Following our usual practice each new man was assigned to an adviser. The advisers are all teachers of Freshmen and are, therefore, fully acquainted with the courses which Freshmen carry and the requirements which have to be met. Whenever any scholastic report is made to the Dean's Office, the same is placed in the hands of the student by his adviser who in this way has an unusual opportunity to counsel and direct the individual student.

The chief value of the system lies in these personal contacts between broad, human, sympathetic members of the faculty and their advisees. The adviser

must command the respect and issue the invitation to friendly intercourse, but the student must accept these overtures and discuss his problems frankly.

The adviser is not a private tutor, nor an administrator with powers usually entrusted to the Dean; nor is he functioning in a system devised to save inferior or unworthy students from dismissal. But his main job is to help the new student to make, with the least possible jar, the transition from a life closely supervised to one that is pretty largely self-regulated. It is the duty of the college to render service at this point.

The members of the staff who assisted the Acting Dean in advisory work during the year were Professors Patterson, Skinner, Rand, Julian and Messrs. Thissell, Bogholt and Porter. Their efforts in behalf of the men assigned to them caused much favorable comment. They deserve especial credit in view of the fact that they were willing to take on these additional duties when they were already pretty well crowded by a heavy teaching schedule.

The scholarship record of the members of the three other classes was reviewed at regular intervals by the Acting Dean and personal conferences arranged in all cases where the work was not satisfactory. In general the scholarship situation showed a gratifying improvement. The number of conditioned and failed courses was less than we had for many years. Through the year about ten per cent of the new men were dropped because of failure in over forty per cent of their work. Considering the number of men involved and that some of these failed were admitted on probation, we have reason to feel that the record is a fairly creditable one.

For the first time in the history of the college, individual photographs were taken of all the Freshmen. These are used by the Dean, the Registrar, and the President and form a part of the permanent record of each student. Their value to administrative officers is almost indispensable and the practice will undoubtedly become a permanent one.

It is a pleasure to call attention to the fact that the year was almost entirely free from grave or threatening student disorders. The "periodic grouch" was conspicuous by its absence. In speaking of the general situation, President Butterfield referred to it in this way: "My feeling is that we have had an unusually good year; as I see it, the best since the war. There has been splendid leadership in the various student activities, a fine spirit of co-operation, a number of progressive measures suggested by the students themselves, and above all an atmosphere of community friendliness and co-operation that is highly gratifying. It occasionally happens that some time during a college year, it seems necessary for students to ventilate some 'grouch' or other, so far as I can recall, this year has been entirely free from anything of the sort."

This kind of spirit somehow grows and thrives when a group of loyal, well prepared and well intentioned students seek to profit by the direction and instruction of an equally loyal, well trained and sympathetic faculty. Surely every effort for good scholarship and satisfactory student conduct must concern itself with all those factors in college life which aim to make every student a contented student so far as possible.

Miss Grace Gallond, our chief clerk, in fact the only clerk we have had since last fall has proved her worth in many ways. She is capable, tactful, and handles the innumerable details connected with absences, appointments and records in a highly acceptable manner. Her fair and straightforward dealing with students has made a good impression. Some way ought to be found to relieve her of some of the minor duties which crowd in on the more important work that would more than comfortably fill her day.

Several modifications of absences' regulations were tried out with good success. Plans have been drawn up and approved for withdrawing the cut privilege from Freshmen. This will go into effect with the class of 1927. We feel very sure that with our present organization and teaching methods, a student loses a great deal if his attendance is irregular. Then, too, it is evident that practically every student enters upon his college work in a rather serious frame of mind. He really wants to succeed. The college does well to make capital of this fact to help him in forming correct habits when he is beginning self-discipline through responsibility.

As to needs, first and foremost come dormitories. We at least should have facilities to house the Freshmen. A great deal of our work could be made more effective if we were able to reach our men more easily. With students scattered all over town in private homes, it is manifestly often impossible for us, under even the best supervisory organization, to learn of discouragements, associations, and conditions early enough to make our remedial work really effective. Any one knows how much clean, handy, and well adapted rooming places contribute towards making a contented student. We hope these dormitories will be provided in the near future.

During the year representatives of the Student Senate, the Inter-Fraternity Council and Adelphia met with the Scholarship Committee for the purpose of working out plans which would help the scholarship of the college generally. Considerable progress was made and some of the recommendations made at the joint meetings have already been put into effect. This co-operative endeavor will undoubtedly bring good results.

William L. Machmer,
Acting Dean.

REPORT OF THE DIRECTOR OF THE GRADUATE SCHOOL.

It is with much satisfaction that I have the privilege of reporting the steady and progressive increase in the effectiveness of the Graduate School. This is due to the wholesome and strengthening influences prevailing in the departments offering graduate work.

What is done and can be done for the development of advanced study in agriculture, whether it be from the scientific approach or in its so-called practical bearings, rests with the growth of the specific fields of activity within agriculture and a free understanding of the significance of each in its relation to the whole. I believe that those who have the direction of graduate work in any of its forms have this grasp of the situation.

Much consideration has been given to the liberalization of graduate study during previous years with the result that some experiments have been tried and others are in progress. This seems to be a subject receiving some thought in all graduate schools. Linked with it is the character of undergraduate preparation which may be seemingly of any nature. This situation throws into the graduate schools preparatory study for the pursuance of advanced study. No two individuals have had exactly the same preparation, accordingly each individual requires specific adjustment. Liberalization, undergraduate preparation, and graduate study of an effective kind go hand in hand in mapping out a course of action although graduate study is very different from our present system of undergraduate study.

Charles E. Marshall,
Director of the Graduate School.

REPORT OF THE DIRECTOR OF SHORT COURSES.

New Courses.

During the past year several new short courses were offered. A series of four, two-weeks courses for experienced dairymen, managers of ice cream plants, milk producers and others were given with marked success by the Dairy Department. The attendance was very satisfactory and the comments made on the course favorable. These short courses differed, in that the student devoted all of his time to practically one subject. The Division of Horticulture inaugurated a ten weeks course in general horticulture for experienced nurserymen. This course was given in co-operation with the New England Nurserymen's Association, the Massachusetts Nurserymen's Association and the Connecticut Nurserymen's Association. Though the attendance in this course was not large, it proved very satisfactory both to the staff and to the student body.

No short courses were discontinued during the past. The work of rehabilitation of disabled veterans of the world war is practically now complete. In the fall of 1923 there were but two federal trainees entering the freshman two-year class.

Supervision of Farm Projects.

At the special request of the Veterans Bureau, the Massachusetts Agricultural College undertook the supervision of farm projects carried on by federal trainees under the authority of the Veterans Bureau. These trainees are usually veterans who have pursued courses in agriculture in this or other colleges and who have now undertaken to put to practical application the knowledge so gained. Three men are employed in the work of supervision for the Veterans Bureau. Mr. George Goodridge, a graduate of this college in the class of 1918. Mr. F. L. Hannaford, formerly employed by the District Office of the Veterans Bureau in Boston. Mr. H. F. Williamson, formerly employed by the State Institute of Applied Agriculture in Long Island. In making provision for advising and counseling with men who have completed their training and who are about to engage in practical work, the Federal Government has taken one of the most forward steps in recent years in agricultural education. Students who have completed a short course of instruction in agriculture and who wish to engage in farming face two problems, credit and expert guidance. Sometime, somewhere provision will have to be made for capitalizing the honesty of ambitious young men who wish to take up farming, and of providing for them such expert supervision as will help insure their chance of success.

Attendance in Courses.

The attendance in all short courses is less than in previous years. Recently obtained figures indicate that this condition is not local but that there has been a sharp falling off in registration in agriculture in many of the agricultural colleges due to the agricultural depression and to the high wages now being paid in other industries.

Supervision of Placement Training.

The supervision of farm placement training has been carried on very efficiently by Paul W. Viets, Supervisor. It is very likely that by next year we shall have to have an assistant to Mr. Viets in this work.

The following tables are included showing enrollment in the Two-Year Course:

A. *Total Yearly Enrollment of Each Year based on Enrollment from September to June.*

	1918.	1919.	1920.	1921.	1922.
Two-Year Course	37	209	295	302	274
Ten Weeks' Winter School	91	63	112	83	84
Summer School	68	238[1]	322[1]	353	127
School for Country Clergymen	–	–	–	19	34
Vocational Poultry Course	5	13	19	26	4

[1] Includes students sent by Federal Board for vocational education.

B. *Age Distribution of Two-Year Students based on Total Enrollment from September to June.*

Age (Years).	1920–21. Number.	1920–21. Per Cent.	1921–22. Number.	1921–22. Per Cent.	1922–23. Number.	1922–23. Per Cent.
16	–	–	–	–	–	–
17	21	7.1	16	5.3	12	4.4
18	34	11.5	26	8.6	20	7.3
19	35	11.9	44	14.6	45	16.4
20	38	12.8	41	13.6	44	16.1
21	27	9.2	25	8.3	26	9.5
22	26	8.9	18	5.9	19	6.9
23	21	7.1	18	5.9	15	5.5
24	16	5.4	15	5.0	13	4.7
25 and over	77	26.1	99	32.8	80	29.2
Total	295	100.00	302	100.00	274	100.00

John Phelan,
Director of Short Courses.

REPORT OF THE DIRECTOR OF THE EXPERIMENT STATION.

The year just past has in general been one of progress. There were no resignations of men holding key positions, and few changes in other positions. The appropriations made by the Legislature of 1923 made possible the strengthening of work in at least three departments, and while rigid economy has been practiced as a matter of general policy, yet amounts available for maintenance were sufficient to give a fair degree of elasticity to the work of most of the departments. The character of the season was such that the producing departments were able to complete their season's program at less than expected cost. In all these respects, therefore, my report is entirely favorable.

Aside from inability to match development of our men by corresponding increases in salaries, the only present serious difficulty in the Station organization has to do with publication of the results of research. Financially this is a small matter, as less than 2 per cent of this entire research budget of the Station is expended in publication. Its present importance lies in the fact that under provisions of State Law all manuscripts submitted for publication at State expense must be approved by the Commissioner of Administration and Finance. This in effect gives to the Commissioner editorial supervision over research publications, something which was probably not contemplated when the law was passed.

During the past year approval on three manuscripts submitted for publication was refused. Decision on several others was withheld over a period of weeks, and in one case months. Requests for information as to the status of these manuscripts have not been answered. As a result the publication program of the year has been wrecked. At the present time the Station Director is unable to give any assurance to members of the staff regarding the possibility of publishing results of completed work. He is not able to so time publications as to make them most timely and most serviceable. Effective co-operation with other agricultural experiment stations and with the United States Department of Agriculture is made exceedingly difficult.

Consideration of the above problems calls attention to the fact that very few people have any adequate understanding of the various ways in which agricultural research work is capitalized. The thought most commonly expressed is that the work is primarily addressed to farmers, and to farmers alone. It is therefore worth while to point out some of the ways in which experiment station work in general, and the work of the Massachusetts Station in particular, is capitalized, and the ways in which it finally brings returns to the people of the State.

A part of the work of the Experiment Station results in immediate possibility of improved farm practice. In such cases the report of the work is and should be rendered directly to farmers. The work of the Department of Botany in studying apple scab control, as carried on in the eastern part of the State; much of the work of the Cranberry Station; and that work of the Department of Agriculture which had to do with the use of fertilizers, find a place in this classification.

In other cases agricultural research affects farmers indirectly, through the medium of products sold for use on the farm. A recent case is that work of the Department of Pomology which resulted finally in the development of a nursery certification plan. Through certification it is now possible to avoid those losses which formerly occurred through the use of misnamed nursery stock. In order that the foundation research work might be fully capitalized, it was necessary on the one hand to show to orchardists the value of certified nursery stock; and on the other hand to demonstrate that the production of such stock would probably be profitable to nurserymen. In this particular case the final report of the research was published with both the farm and the nursery audiences in mind.

The work of the Department of Plant and Animal Chemistry, extending over a period of many years, illustrates a still more complex situation. This department has carried on more investigations in the study of digestibility of cattle feeds than has any other organization. To a limited extent the work is used

directly by farmers, and to them are addressed some of the reports of our research work. A much wider field is ultimately covered, however, in that the results of these studies are incorporated in nearly all standard texts on the feeding of farm animals. Finally, this work has been studied by the manufacturers of commercial feeds, and utilized in a very large way. A commercial industry, therefore, serves as an intermediary between the Station and those farmers who buy the products of this industry.

In other cases, it may be, research work is primarily of value in giving a basis for regulative work on the part of the State or Nation. In this classification comes the comprehensive study of bacillary white diarrhœa of poultry as made by our Department of Veterinary Science. Only through the organization of regulatory work on a comprehensive basis could this work be capitalized so as to be of value to poultry keepers, and through them to the consumers of poultry products. Already, as a result of this basic work, Massachusetts has a most efficient working plan for controlling and eliminating this destructive disease. Other states, through means of the published record of this investigation, are following the lead. The published report of the experiment was addressed to scientific workers alone, particularly those laboring in the field of avian pathology—yet poultry farmers in this and other states are now benefiting immensely.

Finally, it must be recognized that many problems undertaken by the Experiment Station may have subsidiary by-products which are of service to agricultural science even though they may be of no concrete immediate value to agriculture. A fact once established must be published in order that it may be made a matter of easily accessible record. Failure to publish means that the work must be done over again by some other person in some other place, with a probable net loss to the agriculture of the country because of the facts not being fully recorded. Particularly is this the case in the developing study of the economics of the food supply of the State. Not until methods of study become standardized and much preliminary work is done, will it be possible to insure that all efforts along research lines be fully productive. The State, however, expects to learn from the experience of other states. In its turn, other states must be given opportunity to learn from the experience of Massachusetts.

One of the most pressing needs of the Station is a definite publication policy which will insure that all the work of the Station be productively and consistently recorded.

Sidney B. Haskell,
Director of the Experiment Station.

REPORT OF THE DIRECTOR OF THE EXTENSION SERVICE.

At the close of the State fiscal year ending November 30, 1923 I am able to report excellent progress in extension accomplishments, but I feel obliged to report great discouragement concerning prospects.

Accomplishments include the carrying forward of our projects on the general lines planned at the beginning of the year. The wage-competition of industry, particularly contract construction work, has been more keen and more disastrous to agriculture than at any time during the war. More farmers have yielded, and given up agriculture for other occupations than at any other time. On the other hand those farmers who have reorganized their business to meet present opportunities have had a good year. The industrial pressure has hastened the transition from the former type of general agriculture to the newer specialized type. The change was due to come anyway; it only comes more suddenly and violently.

It is more evident than ever that certain types of agriculture, such as sheep raising and hog raising on purchased feeds, are of the past. Certain other lines, as fruit growing and poultry raising, can expand very greatly before market demands are met. Others, as market gardening, can hold their own and make some increase as population increases. Still others, as tobacco growing, onion growing, and cranberry growing, are subject to limitation of soil, disease and

pest rather than to total market requirements and can make substantial growth if these limitations are met.

The year has shown that organizations of farmers on commodity lines can do a great deal to assist in securing adoption of sound practices. We have therefore capitalized such organizations in every possible way, and have endeavored to strengthen their usefulness as much as possible.

Home economics work has developed on a more sound and fundamental basis than ever before, with stress on leader-training. Subject matter is in a better state of development. County home demonstration agents have become heartily convinced of the value of group leader-training. Women have done more effective work as group leaders than ever before.

Work of boys and girls clubs in agriculture and home economics has included more older boys and girls. Numbers show some increase, but numbers are less an index of value than are nature and quality of work done. These have improved.

County budgets have been remarkably sustained in view of the present wave of economy. County staffs have shown but little change.

On the discouraging side of the scale is the ever-increasing difficulty of getting the necessary things done without spending a very considerable part of the time in overcoming objections and obstacles. Entire projects have been imperilled, with the prospect of losing the fruits of years of foundation work, because of failure to allow the means of continuance, even though the funds are in hand. Our nutrition project, commenced in 1913, is at present writing still under discussion in the State House, and months have lapsed during which the county home demonstration agents have no subject-matter leadership. The results of years of work in farm accounting are similarly threatened by failure to allow the publication of necessary account books except under wholly impractical conditions. Our printing program is months behind requirements, owing to difficulties of various sorts. Approval cannot be had of publications for which we are convinced that there is a need; and we are therefore obliged to spend more money than the publication itself would cost in answering questions by mimeograph material or personal correspondence. Failure to receive bills from Wright & Potter between March 1 and November 26 made it impossible for us to have any accurate idea of our commitments. Extreme delays in approval of manuscript give the impression of desire to reduce printing by causing discouragement, and to save money by delaying until the need is over, or by passing the matter into the next year's budget. Our staff do not have heart to write under these handicaps. Refusal in important cases of permission to travel out of state is a still further and most serious discouragement to our people. Our people have worked long hours overtime under conditions of personal discomfort and even of personal cost in order to accomplish their work. When they find themselves further handicapped and penalized by seemingly needless obstructions they are first grieved, then puzzled, and finally ask in disgust "What's the use?" Our standards will be lowered, and the record of our work diminished, if we even approximate the time-serving attitude which comes when the day is standardized, and when it is the habit to leave at closing time regardless of whether work is completed, or not.

During the year three vacancies have occurred by resignation. Mr. A. F. MacDougall resigned as Extension Professor of Farm Management to take up the management of the Middlesex County Extension Service. Mr. Louis M. Lyons resigned as extension editor to become city editor of the Springfield Republican. Lucy M. Queal resigned as nutrition specialist to pursue graduate work in Columbia University.

A full report of the year's work will be ready about January 1, 1924, when statistics are completed.

John D. Willard,
Director.

Table I. — *New Appointments.*

A. In the Academic Departments.

Assistant Professor of Beekeeping: Morton H. Cassidy, B.Sc., Massachusetts Agricultural College, 1920.
Instructor in Pomology: Arthur P. French, B.Sc. Ohio State University, 1921; M.Sc., Massachusetts Agricultural College, 1923.
Professor of Agricultural Education: Harry N. Glick, A.B. Bridgewater College, 1913; A.M., Northwestern University, 1914.
Instructor in Physical Education: Howard R. Gordon, B.Sc., Massachusetts Agricultural College, 1923.
Assistant Professor of Floriculture: Richard T. Muller, B.Sc., Cornell, 1916 M.Sc., Univ. of Maine, 1920.
Instructor in Poultry Husbandry: Marion C. Pulley, B.Sc., Massachusetts Agricultural College, 1919.
Instructor in Pomology: George J. Raleigh, B.Sc., Kansas State College, 1922; M.Sc., University of Nebraska.
Instructor in Farm Law: Harold W. Smart, LL.B. Boston University, 1918.
Instructor in Agricultural Economics: Hubert W. Yount, B.Sc. Ohio State University, 1921; M.Sc., Massachusetts Agricultural College, 1923.

B. In the Experiment Station.

Investigator in Pomology: John S. Bailey, B.Sc., Michigan Agricultural College, 1922; M.Sc., Iowa State College, 1923.
Assistant Research Professor of Botany: William L. Doran, B.Sc., Massachusetts Agricultural College, 1915; M.Sc., 1917.
Assistant Research Professor of Agronomy: John P. Jones, B.Sc., University of Maryland, 1918; M.Sc., University of Maryland, 1921.
Investigator in Agriculture: Donald S. Lacroix, B.Sc., Massachusetts Agricultural College, 1922.
Laboratory Assistant: Gustaf E. R. Lindskog, B.Sc., Massachusetts Agricultural College, 1923.
Assistant Research Professor of Vegetable Gardening: Victor A. Tiedjens, B.Sc., University of Wisconsin, 1921; M.Sc., 1922.
Laboratory Assistant in Pomology: Harold E. Wilson.

C. In the Control Service.

Analyst Control Service: Sylvester J. Broderick, B.Sc., New Hampshire State College, 1922.
Laboratory Assistant in Poultry Disease Elimination: Hazel M. Parker.

D. In the Extension Service.

Extension Assistant Professor of Pomology: Frederick E. Cole, Jr., B.Sc., Massachusetts Agricultural College, 1920.

E. Miscellaneous.

Resident Nurse: Avis P. Christopher
Matron, Infirmary: Mrs. Florence Thomas

Table II. — *Speakers for the Year.*

A. Speakers at Assembly for the Year ending Nov. 30, 1923.

1922

Dec. 7. President L. H. Murlin, Boston
Dec. 14. Dr. Edward H. Hume, China

1923

Jan. 3. Mr. Ralph W. Redman, M. A. C.
Jan. 10. Mr. Norman Thomas, New York City
Jan. 17. Mr. Walter R. Clarke, Milton, N. Y.
Jan. 24. Dr. J. E. Williams, New York City
Jan. 31. President Mary E. Woolley, South Hadley

Feb. 7.	Mr. Arne Kildal, Washington, D. C.
Feb. 14.	Student Forum
Feb. 21.	Dr. J. S. Ferguson, New York City
Feb. 28.	Capt. George A. Parker, Boston
Mar. 7.	Freshmen — Sophomore Debate
Mar. 14.	Rev. J. Franklin Knotts, Northampton
Mar. 28.	Mr. Malcolm W. Davis, New York City
Apr. 4.	Dean Edward M. Lewis, M. A. C.
Apr. 11.	Dr. C. D. Woods, Boston
Apr. 18.	Hon. John M. Gibbs, Waltham
Apr. 25.	Student Forum
May 2.	Burnham Declamation Contest
May 16.	Dr. Robert O. Blood, Concord, N. H.
May 23.	Prof. William L. Machmer, M. A. C.
Sept. 26.	President Kenyon L. Butterfield
Oct. 11.	Prof. Frank A. Waugh, M. A. C.
Oct. 18.	Dr. William E. Barton, Chicago, Ill.
Oct. 25.	Judge Michael H. Sullivan, Boston
Nov. 1.	Mr. George H. Campbell, Baltimore, Md.
Nov. 8.	Student Forum
Nov. 15.	Mrs. Lucia Ames Mead, Boston
Nov. 22.	Mr. Samuel G. Inman, New York City

B. Speakers at Sunday Chapel for Year ending Nov. 30, 1923.

1922	
Dec. 10.	Rev. John Haynes Holmes, New York City
Dec. 17.	Bishop Logan A. Roots, Hankow, China
1923	
Jan. 7.	Bishop Edwin H. Hughes, Malden
Jan. 14.	Dean Charles R. Brown, New Haven, Conn.
Jan. 21.	Rev. Vaughan Dabney, Dorchester
Jan. 28.	Mr. Alfred E. Stearns, Andover
Feb. 4.	Rev. Moses R. Lovell, Durham, N. H.
Feb. 11.	Rev. Robert W. Coe, Norwood
Feb. 18.	Dean James A. Beebe, Boston
Feb. 25.	Dr. Frank W. Sheldon, Boston
Mar. 4.	Dr. W. E. Gilroy, Boston
Mar. 11.	Judge Michael J. Murray, Boston
Mar. 18.	Dr. Nehemiah Boynton, New York City
Apr. 1.	Rev. John B. Hanna, M. A. C.
Apr. 8.	Rev. Edwin B. Robinson, Holyoke
Apr. 15.	Rev. Kenneth C. MacArthur, Cambridge
Apr. 22.	Rev. James G. Gilkey, Springfield
Apr. 29.	Hon. P. Whitwell Wilson, New York City and London
Sept. 30.	President Kenyon L. Butterfield
Nov. 4.	Bishop Francis J. McConnell, Pittsburgh, Penn.
Nov. 11.	Dr. Albert Parker Fitch, New York City
Nov. 18.	Rev. John A. Ryan, D.D., Washington, D. C.
Nov. 25.	Rev. James G. Gilkey, Springfield

Table III. — *Attendance.*

	Registration Nov. 1, 1922.			Registration Nov. 1, 1923.		
A. In Work of College Grade.	Men.	Women.	Total.	Men.	Women.	Total.
Graduate Students	48	6	54	58	5	63
Senior Class	84	7	91	87	7	94
Junior Class	89	6	95	71	4	75
Sophmore Class	91	6	97	120	17	137
Freshman Class	167	20	187	112	13	125
Special Students	9	4	13	10	7	17
Totals	488	49	537	458	53	511
B. Short Course Enrollment.						
Two-Year Course, second year	116	5	121	84	5	89
Two-Year Course, first year	128	8	136	68	12	80
Vocational Poultry Course	8	1	9	4	–	4
Totals	252	14	266	156	17	173
C. Other Short Course Enrollment.						
School for Country Clergymen	31	2	33	32	2	34
Winter School	77	20	97	68	16	84
Summer School	23	147	170	17	110	127
School of Rural Home Life	–	16	16	–	–	–
School for Florists	–	–	–	7	4	11
Totals	131	185	316	156	132	256

D. Convention Registration.	**1922.**	**1923.**
Polish farmers' day	125	100
Farmers' week and annual poultry convention	2,000	2,500
Junior boys' and girls' prize winners' camp	100	75
One-day campers (boys and girls)	70	–
Extension workers conference	80	80
Sheep breeders' conference	100	75
Tri-State Conference on Fruit Growing	150	100
Middlesex County Club Champions	–	200
Hampden County Club Members	–	200
Totals	2,625	3,330

Table IV. — *Legislative Budget, 1923.*

Items.	Requested, 1923.	Appropriated.
Chemistry laboratory and equipment	$150,000	$150,000
Improvements at power plant	39,250	–
Improvements at Tillson Farm	5,000	5,000
Laboratory, horticultural manufactures	38,000	–
Development of market garden field station, Waltham	25,000	–
Women's gymnasium	15,000	–
Addition to rural engineering shops and equipment	15,000	–
Roads	8,000	8,000
Tool sheds and garage, Division of Horticulture	6,000	6,000
Live Stock Replacement	5,000	5,000
Calf Barn	5,000	–
Superintendent's cottage, Tillson Farm	5,000	–
Fencing fruit plantations	3,000	–
New Walks	2,500	2,500
Grading and draining addition to athletic field	2,500	–
Land for cranberry station, East Wareham	1,000	–
Farm house to replace fire loss	–	8,000
Totals	$325,250	$184,500

Table V. — *Current Account, State Funds.*

	Requested 1923.	Appropriated 1923.	Deficiency Appropriation.	Expended 1923.	Balance.
Personal Services:					
Administration	$37,850	$37,600	–	$36,910 97	$689 03
Instruction	198,680	192,000	–	191,012 12	987 88
General Maintenance	122,500	118,000	$49 30	119,451 58	–1,402 28
Experiment Station	72,420	66,750	13 10	62,777 87	3,985 23
Extension Service	52,180	50,000	–	50,098 03	–98 03
Market Garden Field Station	6,000	6,000	–	5,480 94	1,519 06
Market Garden Field Station spl.	–	1,000	–	–	–
Short Courses	53,227	52,600	–	50,763 47	1,836 53
Travel, Office and other exp.	48,695	42,500	852 85	42,898 58	454 27
Teaching, lab. sup. and equip.	55,000	55,000	2,503 62	58,230 93	–727 31
Experiment Station sup. equip. and publications	16,000	14,000	259 31	16,572 04	–2,312 73
Experiment Station travel and office expenses	4,000	4,000	46 48	3,830 04	216 44
Extension Service supplies, equipment, travel, etc.	40,000	35,000	146 11	29,920 83	5,225 28
Short Courses	12,000	12,000	77 69	11,144 02	933 67
Heat, Light and Power	72,000	72,000	583 48	87,464 27	5,119 21
Heat, Light and Power special	–	20,000	–	–	–
Farm and Grounds	20,000	20,000	315 43	21,090 86	–775 43
Repairs, Ordinary	25,000	25,000	234 60	33,488 27	–8,253 67
Replacements	40,000	37,500	1,330 75	38,866 66	–35 91
Market Garden Field Station	4,000	3,200	139 08	3,780 12	–441 04
Fertilizer Law Control	14,500	13,500	9 17	13,325 10	184 07
Poultry Disease Law	7,000	7,500	16 95	7,621 10	–104 15
Milk Testing Inspection Law	600	600	–	544 15	55 85
Trustees' Expenses	1,200	1,200	169 17	1,404 61	–35 44
Printing Reports	2,000	2,000	–	1,744 94	255 06
Commercial Feedstuffs	9,000	9,000	–	8,459 64	540 36
	$913,852	$897,950	$6,747 09	$896,881 14	$7,815 85

Table VI. — *Statistics of Freshmen entering Massachusetts Agricultural College September 1923.*

A. Home Addresses of Students (classified by Towns and Cities).

Abington	2	Greenfield	2	Quincy	1
Acton	1	Hadley	3	Rockland	1
Amesbury	1	Hatfield	1	Russia	1
Amherst	9	Hingham	1	Sharon	1
Arlington	1	Holyoke	7	Sherborn	1
Ashby	1	Hubbardston	1	Southbridge	1
Barnstable	1	Hudson	1	Southwick	1
Becket	1	Leverett	1	Springfield	5
Belmont	1	Lexington	1	Stoneham	2
Beverly	1	Malden	3	Stoughton	1
Billerica	1	Manchester	1	Sutton	1
Boston	7	Marlborough	1	Templeton	1
Brookfield	1	Medford	2	Tisbury	1
Cambridge	1	Medway	1	Wakefield	1
Canaan, Conn.	1	Minneapolis, Minn.	1	Waltham	2
Charlton	1	Montague	2	Westborough	1
Chelsea	1	Natick	3	West Bridgewater	1
Clinton	1	New Bedford	1	Westfield	1
Deerfield	1	New London, Conn	1	West Springfield	2
Dracut	1	Newton	1	West Stockbridge	1
Duxbury	1	North Adams	1	Wilbraham	1
East Bridgewater	1	Northampton	1	Williamsburg	2
Easthampton	2	Northbridge	1	Wilmington	2
Easton	1	North Brookfield	1	Winchester	1
Enfield	1	Northfield	2	Woburn	1
Everett	1	Pittsfield	2	Worcester	1
Fair Haven, Vt.	1	Plymouth	1	Wrentham	1
Fall River	1	Portland, Maine	1		

B. Home Addresses (classified by States and Countries).

	Number.	Per Cent.		Number.	Per Cent.
Connecticut	2	1.60	Russia	1	.80
Maine	1	.80	Vermont	1	.80
Massachusetts	119	95.20			
Minnesota	1	.80		125	100.00

C. Home Addresses (classified by Counties of Massachusetts).

	Number.	Per Cent.		Number.	Per Cent.
Barnstable	1	.84	Middlesex	30	25.21
Berkshire	5	4.20	Norfolk	5	4.20
Bristol	3	2.52	Plymouth	8	6.72
Dukes	1	.84	Suffolk	8	6.72
Essex	3	2.52	Worcester	11	9.24
Franklin	8	6.72			
Hampden	17	14.27		119	99.97
Hampshire	19	15.97			

D. Nativity of Parents.	Number.	Per Cent.
Neither parent foreign born	78	62.40
Both parents foreign born	27	21.60
Father (only) foreign born	10	8.00
Mother (only) foreign born	10	8.00
	125	100.00
E. Education of Father.		
Common school	55	44.00
High School	36	28.80
Business School	6	4.80
College or University	22	17.60
No statistics	6	4.80
	125	100.00

F. Religious Census.

	Membership.		Preference.		Totals.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
Baptist	8	6.4	1	.8	9	7.2
Catholic	24	19.2	–	–	24	19.2
Congregationalist	31	24.8	13	10.4	44	35.2
Episcopal	5	4.0	–	–	5	4.0
Methodist	10	8.0	4	3.2	14	11.2
Presbyterian	1	.8	–	–	1	.8
Unitarian	9	7.2	4	3.2	13	10.4
Universalist	–	–	2	1.6	2	1.6
Miscellaneous	8	6.4	3	2.4	11	8.8
No statistics	–	–	2	1.6	2	1.6
	96	76.8	29	23.2	125	100.0

G. Occupation of Father.

	Number.	Per Cent.
Agriculture and horticulture	34	27.20
Artisans	38	30.40
Business	18	14.40
Deceased or no statistics	9	7.20
Miscellaneous	16	12.80
Professional	10	8.00
	125	100.00

H. Intended Vocation of Student.

Agriculture or horticulture (practical)	41	32.80
Agriculture or horticulture (professional)	40	32.00
Professions	14	11.20
Miscellaneous	18	14.40
Undecided or no statistics	12	9.60
	125	100.00

I. Farm Experience.

Brought up on a farm	41	32.80
Not brought up on a farm and having no or practically no farm experience	32	25.60
Not brought up on a farm, but having had some farm experience	52	41.60
	125	100.00

J. Miscellaneous Statistics.

Average Age (years) 18.90

REPORT OF THE TREASURER

For the Fiscal Year ending Nov. 30, 1923.

BALANCE SHEET.

		Dr.	Cr.
1922			
Dec. 1.	To balance on hand	$37,379 40	
1923			
Nov. 30.	To departmental income	151,288 70	
Nov. 30.	To receipts from State Treasurer	950,582 97	
Nov. 30.	To refunds to State Treasurer	196 41	
Nov. 30.	To receipts from United States Treasurer	111,719 54	
Nov. 30.	To November and October schedule in transit	113,316 40	
Nov. 30.	Refunds transferred to State Treasurer		$196 41
Nov. 30.	Expenditures for fiscal year		1,175,602 23
Nov. 30.	Income transferred to State Treasurer		151,288 70
Nov. 30.	Balance on hand		37,396 08
		$1,364,483 42	$1,364,483 42

STATEMENT OF LEGISLATIVE APPORTIONMENT AND EXPENDITURES FOR FISCAL YEAR ENDING NOVEMBER 30, 1923, AND APPORTIONMENT REQUESTED FOR 1924.

	Apportionment for Last Fiscal Year.		Expenditures.		Requested Apportionment for New Fiscal Year.	
College:						
Personal services	$347,649 30		$347,374 67		$370,704 00	
Maintenance	238,989 98	$586,639 28	243,172 91	$590,547 58	213,375 00	$584,079 00
Experiment Station:						
Personal services	$66,750 00		$62,777 87		$87,935 00	
Maintenance	18,305 79	85,055 79	20,402 08	83,179 95	22,050 00	109,985 00
Extension Service:						
Personal services	$50,013 10		$50,098 03		$55,788 00	
Maintenance	35,146 11	85,159 21	29,920 83	80,018 86	40,400 00	96,188 00
Short Courses:						
Personal services	$52,600 00		$50,763 47		$60,357 00	
Maintenance	12,077 69	64,677 69	11,144 02	61,907 49	15,350 00	75,707 00
Market Garden Field Station:						
Personal services	$7,000 00		$5,480 94		$6,000 00	
Maintenance	3,339 08	10,339 08	3,780 12	9,261 06	4,400 00	10,400 00
Trustees travel	$1,369 17		$1,404 61		$1,200 00	
Printing reports	2,000 00		1,744 94		2,000 00	
Commercial feedstuffs	9,000 00		8,459 64		9,500 00	
Totals		12,369 17		11,609 19		12,700 00
Fertilizer law	$13,509 17		$13,325 10		$13,500 00	
Poultry law	7,516 95		7,621 10		8,000 00	
Milk testing law	600 00		544 15		600 00	
Totals		21,626 12		21,490 35		22,100 00
Replacements	$38,830 75	38,830 75	$38,866 66	38,866 66	$27,500 00	27,500 00
Totals		$904,697 09		$896,881 14		$938,659 00
Balance unexpended		–		7,815 95		–
		–		$904,697 09		–

CASH STATEMENT.

	Other Funds.	State Funds.
Balance Dec. 1, 1922	$37,379 40	–
Receipts.		
College receipts from students and others:		
Tuition	–	$5,197 57
Laboratory fees	–	6,849 19
Rents	–	11,855 88
Departmental sales:		
Produce	–	66,508 98
Miscellaneous	–	8,371 02
Experiment Station:		
Cranberry receipts	–	474 53
Chemical receipts	–	473 18
Miscellaneous	–	2,568 51
Extension Service:		
Correspondence Courses	–	1,261 75
Miscellaneous	–	142 71
Short Courses:		
Students' fees	–	4,887 14
Winter school	–	366 00
Miscellaneous	–	–
Market Garden Field Station:		
Produce	–	3,363 57
Feed Law	–	19,726 00
Fertilizer Law	–	14,504 18
Milk Testing Law	–	779 85
Poultry Disease Law	–	3,958 64

	Other Funds.	State Funds.
Treasurer of the Commonwealth:		
Maintenance	–	$802,887 68
Special appropriations	–	142,431 97
Endowment	$3,313 32	–
Department of Education	1,950 00	–
Federal Government:		
Land Grant of 1862	7,300 00	–
Hatch Fund of 1887	15,000 00	–
Morrill Fund of 1890	16,666 67	–
Adams Fund of 1906	15,000 00	–
Nelson Fund of 1907	16,666 66	–
Smith Lever Fund of 1914	31,234 76	–
Short Course, Federal Project	9,650 00	–
Short Course, Two Years	201 45	–
November and October schedules in transit	–	113,316 40
	$154,362 26	$1,209,924 75

Payments.

	Other Funds.	State Funds.
College expenses:		
Personal services	$45,896 65	$347,374 67
Maintenance	–	243,172 91
Experiment Station:		
Personal services	27,330 00	62,777 87
Maintenance	2,389 00	20,402 08
Extension service:		
Personal services	26,893 45	50,098 03
Maintenance	2,558 72	29,920 83
Short Courses:		
Personal services	7,538 23	50,763 47
Maintenance	4,360 13	11,144 02
Market Garden Field Station:		
Personal services	–	5,480 94
Maintenance	–	3,780 12
Trustees travel	–	1,404 61
Printing reports	–	1,744 94
Replacements	–	38,866 66
Commercial feedstuffs	–	8,459 64
Fertilizer law	–	13,325 10
Milk testing law	–	544 15
Poultry disease law	–	7,621 10
Special appropriations:		
1922 Chemistry Laboratory	–	128,554 94
1922 Power Plant Improvements	–	4,395 29
1922 Tillson Farm Improvements	–	181 35
1923 Tenement House	–	2,243 57
1923 Tillson Farm Improvements	–	4,170 55
1923 Tool shed and Garage	–	5,024 42
1923 New Walks	–	2,239 94
1923 Road Improvements	–	7,991 61
1923 Livestock	–	2,067 28
1915 Microbiology Building	–	4,885 96
Income	–	151,288 70
Balance	37,396 08	–
	$154,362 26	$1,209,924 75

Current Accounts, 1923.

Disbursements and Receipts.

Accounts.	Disbursements from Nov. 30, 1922, to Nov. 30, 1923.	Receipts from Nov. 30, 1922, to Nov. 30, 1923.	Apportionment for Year ending Nov. 30, 1923.	Balance to Credit.
Dean's Office	$767 66	–	$701 73	—$65 93
Executive Order	10,242 36	$0 63	12,150 15	1,907 79
President's Office	1,989 60	3 76	2,032 47	42 87
Registrar's Office	631 08	–	850 74	219 66
Salaries	36,910 97	–	37,600 00	689 03
Treasurer's Office	1,372 29	85 93	1,702 66	330 37
Maintenance, Academic:				
Agricultural Economics	434 85	–	551 00	116 15
Agricultural Education	209 79	–	407 93	198 14
Agronomy	1,173 23	329 00	1,200 72	27 49
Animal Husbandry	557 57	117 50	602 74	45 17
Beekeeping	319 25	–	350 00	30 75
Botany	1,577 58	746 00	1,605 60	28 02
Chemistry	7,236 32	1,654 00	7,328 97	92 65
Dairying	32,787 65	24,991 24	32,185 05	—602 60
Domestic Science	1,531 59	119 50	1,434 06	—97 53
Economics and Sociology	75 83	–	150 73	74 90
Entomology	1,217 75	137 00	1,304 00	86 25
Farm Management	402 01	62 50	507 45	105 44
Floriculture	7,343 36	2,777 43	7,511 62	168 26
Forestry	272 26	–	351 15	78 89
General Agriculture	2,419 15	–	2,500 00	80 85
Horticultural Mfgs.	3,328 38	564 27	3,533 99	205 61
Hospital	4,383 29	845 05	3,361 24	—1,022 05
Landscape Gardening	344 72	361 84	502 55	157 83
Language and Literature	292 10	163 00	300 00	7 90
Mathematics	345 75	47 00	400 15	54 40
Microbiology	1,988 76	451 85	2,405 34	416 58
Military Science	1,673 64	33 50	1,700 95	27 31
Mount Toby	3,479 64	8 25	3,505 35	25 71
Physical Education	1,621 30	767 80	1,350 00	—271 30
Physics	719 21	66 00	776 53	57 32
Pomology	5,497 17	2,694 11	5,506 61	9 44
Poultry Husbandry	16,712 90	19,416 31	14,544 92	—2,167 98
Rural Engineering	888 44	105 50	900 25	11 81
Rural Sociology	113 12	–	201 75	88 63
Vegetable Gardening	6,634 72	2,333 99	6,501 12	—133 60
Veterinary Science	2,399 44	100 00	2,361 30	—38 14
Women's Dormitory	3,019 34	–	2,710 62	—308 72
Zoölogy and Geology	473 79	110 00	650 25	176 46
Maintenance, General:				
Farm	16,778 87	1,233 02	13,560 93	—3,217 94
General Horticulture	9,250 44	157 66	9,018 73	—231 71
Graduate School	82 44	–	200 00	117 56
Grounds	8,370 38	–	9,500 00	1,129 62
Library	7,113 20	96 56	8,096 08	982 88
Livestock	28,361 93	14,359 88	23,754 50	—4,607 43
General Expense	648 80	1,496 69	–	–
Operating and Maintenance	165,541 54	22,345 87	165,895 13	353 59
Replacements	38,866 66	–	38,830 75	—35 91
Endowment Fund	10,613 32	10,613 32	10,613 32	3,650 00
Instruction:				
Salaries	191,012 12	–	192,000 00	987 88
U. S. Treasurer, Morrill Fund	16,666 67	16,666 67	16,666 67	9,722 22
U. S. Treasurer, Nelson Fund	16,666 66	16,666 66	16,666 66	9,722 21
State Treasurer, Account of schedules	–	629,414 24	–	–
Income to State Treasurer	98,782 64	–	–	–
	$772,143 53	$772,143 53	$669,044 46	$19,426 80
Balance beginning fiscal year, Dec. 1, 1922	–	23,094 43	–	–
Balance on hand Nov. 30, 1923	23,094 43	–	–	–
	$795,237 96	$795,237 96	–	–

College Accounts.

Summary.

	Disbursements.	Receipts.
Cash on hand Dec. 1, 1922	–	$23,094 43
Institution receipts Nov. 30, 1923	–	98,782 64
State Treasurer's receipts Nov. 30, 1923	–	629,414 24
United States Treasurer's receipts Nov. 30, 1923	–	33,333 33
State Treasurer, Department of Education	–	1,950 00
State Treasurer, Endowment fund	–	10,613 32
Total Disbursements	$675,310 89	–
Receipts turned in to State Treasurer	98,782 64	–
	$774,093 53	$797,187 96
Bills receivable Dec. 1, 1922 deducted	–	14,219 25
Bills payable Dec. 1, 1922, deducted	1,063 12	–
	$773,030 41	$782,968 71
Bills receivable Nov. 30, 1923	–	11,029 42
Bills payable Nov. 30, 1923	1,961 24	–
Balance	19,006 48	–
	$793,998 13	$793,998 13

Net Costs of the Departments.

Department.	Salaries.	Labor.	Maintenance.	Total.	Receipts.	Balance.
Dean's Office	$5,125 00	$382 75	$384 91	$5,892 66	–	$5,892 66
Executive Order	1,155 00	1,037 50	9,204 86	11,397 36	$0 63	11,396 73
President's Office	15,473 57	318 19	1,671 41	17,463 17	3 76	17,459 41
Registrar's Office	–[1]	95 57	535 51	631 08	–	631 08
Treasurer's Office	15,157 40	219 69	1,152 60	16,529 69	85 93	16,443 76
Totals	$36,910 97	$2,053 70	$12,949 29	$51,913 96	$90 32	$51,823 64
Instruction and Maintenance.						
Agricultural Economics	$8,932 97	$62 49	$372 36	$9,367 82	–	$9,367 82
Agricultural Education	6,518 35	–	209 79	6,728 14	–	6,728 14
Agronomy	8,785 00	581 33	591 90	9,958 23	$329 00	9,629 23
Animal Husbandry	5,560 00	79 77	477 80	6,117 57	117 50	6,000 07
Beekeeping	1,440 00	114 15	205 10	1,759 25	–	1,759 25
Botany	11,955 13	349 00	1,228 58	13,532 71	746 00	12,786 71
Chemistry	13,581 98	945 09	6,291 23	20,818 30	1,654 00	19,164 30
Dairying	7,215 00	6,272 05	26,515 60	40,002 65	24,991 24	15,011 41
Dean's Office	2,576 61	–	–	2,576 61	–	2,576 61
Domestic Science	6,954 43	227 00	1,304 59	8,486 02	119 50	8,366 52
Economics and Sociology	3,208 33	–	75 83	3,284 16	–	3,284 16
Entomology	10,707 00	735 70	482 05	11,924 75	137 00	11,787 75
Farm	–	24,049 94	21,090 86	45,140 80	15,592 90	29,547 90
Farm Management	5,500 01	84 20	317 81	5,902 02	62 50	5,839 52
Floriculture	2,865 00	6,056 27	1,287 09	10,208 36	2,777 43	7,430 93
Forestry	2,530 02	150 97	121 29	2,802 28	–	2,802 28
General Agriculture	3,846 53	1,820 29	598 86	6,265 68	–	6,265 68
General expense	–	1,955 17	Cr. 1,306 37	648 80	1,496 69	–847 89
General Horticulture	10,440 01	5,898 51	3,351 93	19,690 45	157 66	19,532 79
Graduate School	–	–	82 44	82 44	–	82 44
Grounds	–	7,335 30	1,035 08	8,370 38	–	8,370 38
Horticultural Manufactures	5,340 00	1,623 46	1,704 92	8,668 38	564 27	8,104 11
Hospital	–	2,430 92	1,952 37	4,383 29	845 05	3,538 24
Landscape Gardening	3,289 00	–	344 72	3,633 72	361 84	3,271 88

[1] Registrar's Office Salaries included in "Instruction and Maintenance."

Net Costs of the Departments — *Concluded.*

Instruction and Maintenance — Con.	Salaries.	Labor.	Maintenance.	Total.	Receipts.	Balance.
Language and Literature	$22,203 33	$13 97	$278 13	$22,495 43	$163 00	$22,332 43
Library	8,888 61	1,600 36	5,512 84	16,001 81	96 56	15,905 25
Mathematics	10,740 00	206 05	139 70	11,085 75	47 00	11,038 75
Microbiology	11,045 00	736 20	1,252 56	13,033 76	451 85	12,581 91
Military	600 00	280 28	1,393 36	2,273 64	33 50	2,240 14
Mount Toby	–	3,270 63	209 01	3,479 64	8 25	3,471 39
Operating and Maintenance	–	32,478 73	133,062 81	165,541 54	22,345 87	143,195 67
Physical Education	10,270 00	755 63	865 67	11,891 30	767 80	11,123 50
Physics	8,370 00	186 53	532 68	9,089 21	66 00	9,023 21
Pomology	6,430 01	4,407 72	1,089 45	11,927 18	2,694 11	9,233 07
Poultry Husbandry	9,285 00	3,535 04	13,177 86	25,997 90	19,416 31	6,581 59
Registrar's Office	2,160 00	–	–	2,160 00	–	2,160 00
Rural Engineering	5,900 00	378 84	509 60	6,788 44	105 50	6,682 94
Rural Sociology	4,790 00	–	113 12	4,903 12	–	4,903 12
Replacements	–	–	38,866 66	38,866 66	–	38,866 66
Vegetable Gardening	2,445 00	5,080 31	1,554 41	9,079 72	2,333 99	6,745 73
Veterinary	5,476 45	1,350 86	1,048 58	7,875 89	100 00	7,775 89
Women's Dormitory	–	2,274 74	744 60	3,019 34	–	3,019 34
Zoölogy and Geology	5,110 00	70 38	403 41	5,583 79	110 00	5,473 79
Totals	$234,958 77	$117,397 88	$269,090 28	$621,446 93	$98,692 32	$522,754 61
Grand Totals	$271,869 74	$119,451 58	$282,039 57	$673,360 89	$98,782 64	$574,578 25

$10,613 32	Land Grant and Endow.
33,333 33	Morrill & Nelson
191,012 12	Instruction
36,910 97	Administration
$271,869 74	
1,950 00	Dept. of Education
$273,819 74	

College Expenses as per Cash Statement:

$636,444 23	
38,866 66	
$675,310 89	

Total of this Statement:

$673,360 89	
1,950 00	Dept. of Education
$675,310 89	

Farm Disbursements.

	Repairs.	Labor.	Equipment.	Feed.	Supplies.	Sundry.	Bedding.	Fertilizer.	Seeds.	Impts.	Totals.
Dairy Cattle	–	$6,115 73	$339 90	$197 56	$1,841 20	$1,468 60	–	–	–	–	$9,962 99
Horses	–	1,649 67	5 67	–	19 44	119 34	–	–	–	–	1,794 12
Sheep	–	1,210 31	29 60	–	49 42	25 78	–	–	–	–	1,315 11
Swine	–	1,258 50	–	312 40	5 88	50 01	–	–	–	–	1,626 79
Supplies	–	609 48	–	10,870 98	–	–	$2,182 46	–	–	–	13,662 92
Teams	–	−20 97	314 42	–	–	217 50	–	–	–	–	510 95
Field crops	–	6,356 41	–	–	4 44	21 00	–	$480 59	$262 25	–	7,124 69
Tools & Mach.	$708 15	631 51	205 13	–	552 07	–	–	–	–	–	2,096 86
Miscellaneous	–	6,239 30	–	–	86 17	277 44	–	–	–	$443 46	7,046 37
Totals	$708 15	$24,049 94	$894 72	$11,380 94	$2,558 62	$2,179 67	$2,182 46	$480 59	$262 25	$443 46	$45,140 80

Farm Credits.

	Wool.	Milk.	Stock.	Sundry.	Labor.	Field Crops.	Tools and Machinery.	Improvements.	Totals.
Dairy Cattle	–	$7,697 71	$3,997 22	$32 06	–	–	–	–	$11,726 99
Horses	–	–	30 00	–	–	–	–	–	30 00
Sheep	–	–	1,297 51	–	–	–	–	–	1,297 51
Swine	–	–	1,305 38	–	–	–	–	–	1,305 38
Supplies	–	–	–	–	–	–	–	–	–
Teams	–	–	–	–	$108 00	–	–	–	108 00
Field Crops	–	–	–	–	–	$124 10	–	–	124 10
Tools & Machinery	–	–	–	–	–	–	$28 00	–	28 00
Miscellaneous	–	–	–	–	168 60	–	–	$804 32	972 92
Totals	–	$7,697 71	$6,630 11	$32 06	$276 60	$124 10	$28 00	$804 32	$15,592 90

Agricultural Division.

Disbursements and Receipts.

	Disbursements.	Receipts.
Agronomy	$1,173 23	$329 00
Animal husbandry	557 57	117 50
Dairying	32,787 65	24,991 24
Farm	35,408 30	15,332 80
Farm management	402 01	62 50
Poultry husbandry	16,712 90	19,416 31
Rural engineering	888 44	105 50
Division totals	$87,930 10	$60,354 85

Summary.

	Dr.	Cr.
By total division receipts		$60,354 85
By bills receivable		9,769 94
By net apportionment		26,901 71
To total division disbursements	$87,930 10	
To bills payable	624 71	
Balance	8,471 69	
	$97,026 50	$97,026 50

Inventory of Quick Assets.

	Nov. 30, 1922.	Nov. 30, 1923.
Inventory of produce	$13,038 91	$16,370 55
Inventory of cattle	19,510 00	22,855 00
Inventory of swine	1,487 00	1,481 00
Inventory of horses	3,800 00	3,775 00
Inventory of poultry	4,243 75	4,783 50
Inventory of sheep	1,805 00	2,020 00
	$43,884 66	$51,284 55

Horticultural Division.

Disbursements and Receipts.

	Disbursements.	Receipts.
Floriculture	$7,343 36	$2,777 43
Forestry	272 26	–
General horticulture	9,250 44	157 66
Grounds	8,370 38	–
Horticultural manufactures	3,328 38	564 27
Landscape gardening	344 72	361 84
Mount Toby	3,479 64	8 25
Pomology	5,497 17	2,694 11
Vegetable gardening	6,634 72	2,333 99
Division totals	$44,521 07	$8,897 55

Summary.

	Dr.	Cr.
By total division receipts		$8,897 55
By bills receivable		1,087 98
By net apportionment		37,033 57
To total division disbursements	$44,521 07	
To bills payable	136 96	
By balance	2,361 07	
	$47,019 10	$47,019 10

Inventory of Quick Assets.

	Nov. 30, 1922.	Nov. 30, 1923.
Floriculture	$1,800 00	$2,700 00
General horticulture (live stock)	1,385 00	1,140 00
Horticultural manufactures	420 00	295 00
Mount Toby	98 75	78 40
Pomology	1,300 00	575 00
Vegetable gardening	75 00	547 00
	$5,078 75	$5,335 40

Experiment Station.

Disbursements and Receipts.

	Disbursements from Dec. 1, 1922, to Nov. 30, 1923.	Receipts from Dec. 1, 1922, to Nov. 30, 1923.	Apportionment for year ending Nov. 30, 1923.	Balance to Credit.
Administration	$1,553 67	–	$1,643 15	$89 48
Agricultural	10,946 73	$306 99	10,975 00	28 27
Agricultural economics	803 02	–	1,050 00	246 98
Animal husbandry	100 91	–	–	−100 91
Asparagus	–	–	140 00	140 00
Botanical	2,982 67	–	2,808 25	−174 42
Chemical	2,868 02	473 18	4,109 52	1,241 50
Cranberry	3,501 14	474 53	4,030 20	529 06
Entomological	663 95	–	1,102 90	438 95
Farm management	192 00	–	200 00	8 00
Freight and Express	442 40	–	400 00	−42 40
Library	891 39	–	1,034 29	142 90
Meteorology	468 93	–	600 00	131 07
Microbiology	916 69	–	1,003 46	86 77
Pomology	3,242 38	2,261 52	3,046 06	−196 32
Poultry	4,323 65	–	3,624 57	−699 08
Publications	1,234 87	–	2,011 39	776 52
Salaries	76,722 25	–	76,077 00	−645 25
Treasurer's office	309 26	–	400 00	90 74
Veterinary	735 02	–	800 00	64 98
Hatch fund	–	15,000 00	–	–
Adams fund	–	15,000 00	–	–
State Treasurer, account of schedules	–	83,179 95	–	–
Income remitted to State Treasurer	3,516 22	–	–	–
	$116,415 17	$116,696 17	$115,055 79	$2,156 84
Balance beginning fiscal year Dec. 1, 1922	–	3,994 00	–	–
Balance on hand Nov. 30, 1923	4,275 00	–	–	–
	$120,690 17	$120,690 17	–	–

Summary.

	Disbursements.	Receipts.
Cash on hand Dec. 1, 1922	–	$3,994 00
Receipts from State Treasurer	–	83,179 95
Receipts from United States Treasurer	–	30,000 00
Receipts from other sources	–	3,516 22
Total Disbursements	$112,898 95	–
Receipts turned in to State Treasurer	3,516 22	–
	$116,415 17	$120,690 17
Bills receivable Dec. 1, 1922 deducted	–	1,046 60
Bills payable Dec. 1, 1922 deducted	34 43	–
	$116,380 74	$119,643 57
Bills receivable Nov. 30, 1923	–	1,273 14
Bills payable Nov. 30, 1923	329 96	–
Balance	4,206 01	–
	$120,916 71	$120,916 71

Extension Service.

Disbursements and Receipts.

Classification.	Disbursements.	Receipts.	Apportionment.	Balance.
Administration	$2,156 35	$97 86	$3,514 64	$1,358 29
Animal husbandry	585 31	–	1,001 50	416 19
Clothing efficiency	2,168 86	–	1,207 60	–961 26
Co-op. Marketing	489 18	–	900 30	411 12
Correspondence Courses	2,827 50	1,261 75	2,100 60	–726 90
County Agents Work	987 73	–	1,210 06	222 33
Dairying	196 08	–	300 00	103 92
Exhibits	238 31	–	752 30	513 99
Extension Courses at College	1,868 13	–	1,500 00	–368 13
Extension schools	489 17	–	250 60	–238 57
Farm management demonstration	935 27	16 50	1,202 95	267 68
Forestry	21 10	–	200 00	178 90
Home economics	2,080 98	27 10	2,016 87	–64 11
Home gardening	537 76	–	500 00	–37 76
Horticultural manufactures	1,554 49	–	1,201 75	–352 74
Junior extension work	5,349 89	–	5,518 09	168 20
Landscape extension	217 61	–	826 05	608 44
Lectures	105 90	–	125 00	19 10
Library extension	152 43	–	241 50	89 07
Nutrition and household management	1,667 98	–	1,817 25	149 27
Plant diseases	11 02	–	–	–11 02
Pomology	1,237 78	–	1,501 65	263 87
Poultry husbandry	1,010 16	–	1,200 60	190 44
Printing	2,691 45	1 25	4,756 15	2,064 70
Personal services	50,098 03	–	50,013 10	–84 93
Rural engineering	14 04	–	400 00	385 96
Soils and crops	326 35	–	900 65	574 30
State Treasurer, acccount of schedules	–	80,018 86	–	–
Income to State Treasurer	1,404 46	–	–	–
	$81,423 32	$81,423 32	$85,159 21	$5,140 35

Summary.

	Disbursements.	Receipts.
Balance Dec. 1, 1922[1]	–	$7,303 82
Receipts Nov. 30, 1923	–	$1,404 46
Received from State Treasurer	–	80,018 86
Received from United States Treasurer	–	31,234 76
Disbursements to Nov. 30, 1923[1]	$109,471 03	–
Receipts turned into State Treasurer	1,404 46	–
	$110,875 49	$119,961 90
Bills receivable Dec. 1, 1922 deducted	–	55 47
Bills payable Dec. 1, 1922 deducted	–	–
	$110,875 49	$119,906 43
Bills receivable Nov. 30, 1923	–	23 32
Bills payable Nov. 30, 1923	58 84	–
Balance	8,995 42	–
	$119,929 75	$119,929 75

[1] Includes Federal Smith Lever Fund.

Smith-Lever Fund (Federal).

	Disbursements.	Receipts.
Administration	$207 91	–
Animal husbandry	111 66	–
Clothing efficiencies	86 98	–
Co-operative marketing	79 87	–
Dairying	13 79	–
District and county agents	77 25	–
Farm management demonstration	5 08	–
Forestry	22 24	–
Home economics	111 02	–
Home gardening	139 76	–
Horticultural manufactures	287 99	–
Junior extension works	914 60	–
Landscape gardening	47 36	–
Nutrition and household management	71 98	–
Pomology	123 82	–
Poultry husbandry	152 02	–
Salaries	26,893 45	–
Soils and crops	105 39	–
State Treasurer	–	$31,234 76
	$29,452 17	$31,234 76
Balance beginning fiscal year December 1, 1922	–	7,303 82
Balance on hand November 30, 1923	9,086 41	–
Totals	$38,538 58	$38,538 58

Short Courses.

	Disbursements.	Receipts.	Apportionment.	Balance.
Agricultural economics	$14 97	–	$100 00	$85 03
Agronomy	477 00	$318 00	501 25	24 25
Animal husbandry	97 79	96 00	100 00	2 21
Dairying	3,000 50	401 00	3,000 00	−50
Domestic science	91 25	–	100 00	8 75
Entomology	85 20	–	50 00	−35 20
Farm Management	11 28	–	50 00	38 72
Floriculture	89 01	58 50	100 00	10 99
Forestry	–	–	100 00	100 00
General horticulture	138 33	111 50	217 39	79 06
Horticulture manufactures	651 30	–	750 00	98 70
Library	43 14	–	150 00	106 86
Microbiology	49 54	35 00	50 00	46
Pomology	919 10	–	1,047 05	127 95
Poultry husbandry	480 25	459 00	600 00	119 75
Personal services	50,763 47	–	52,600 00	1,836 53
Rural Engineering	852 13	393 00	851 56	−57
Short Course office	3,691 34	–	3,810 44	119 10
Treasurer's office	168 35	–	200 00	31 65
Tuition	–	2,937 14	–	–
Vegetable gardening	283 54	78 00	300 00	16 46
Winter school registration	–	366 00	–	–
Totals	$61,907 49	$5,253 14	$64,677 69	$2,770 20

Summary.

	Dr.	Cr.
State Appropriation		$64,677 69
Amount of receipts		5,253 14
Amount of receipts transferred to State Treasurer	$5,253 14	
Department expenditures	61,907 49	
Balance unexpended	2,770 20	
Totals	$69,930 83	$69,930 83

Market-Gardening Field Station.

	Debit.	Credit.
Labor	$5,480 94	
Maintenance	3,780 12	
Totals	$9,261 06	
State Appropriation		$10,339 08
Amount of receipts		3,363 57
Amount of receipts transferred to State Treasurer	$3,363 57	
Department expenditures	9,261 06	
Balance unexpended	1,078 02	
Totals	$13,702 65	$13,702 65

Special Appropriations.

	Date made.	Appropriations.	Amount Expended to Date.	Unexpended Balance.
Chemistry Laboratory	1922	$300,000 00	$185,275 31	$114,724 69
Power Plant Improvements	1922	63,000 00	63,000 00	–
Tillson Farm Improvements	1922	5,000 00	5,000 00	–
Tenement House	1923	8,000 00	2,243 57	5,756 43
Tillson Farm Improvements	1923	5,000 00	4,170 55	829 45
Tool Shed and Garage	1923	6,000 00	5,024 42	975 58
Walks	1923	2,500 00	2,239 94	260 06
Roads	1923	8,000 00	7,991 61	8 39
Live stock	1923	5,000 00	2,067 28	2,932 72
Microbiology Building	1915	4,887 61	4,885 96	1 65
	–	$407,387 61	$281,898 64	$125,488 97
Amount spent previous to Dec. 1, 1922	–	–	–	120,143 73
Amount expended during fiscal year	–	–	–	161,754 91
Unexpended balance Nov. 30, 1923	–	–	125,488 97	–
	–	$407,387 61	$407,387 61	$407,387 61

Inventory — Real Estate.

Land (Estimated Value).

Angus land	$800 00
Allen place	500 00
Baker place	2,500 00
Bangs place	2,350 00
Brooks farm	11,000 00
Brown land	500 00
Charmbury place	450 00
Clark place	4,500 00
College farm	37,000 00
Cranberry land	12,745 00
George Cutler, Jr., Trustee	2,700 00
Dickinson land	7,850 00
Harlow farm and orchard	3,284 63
Hawley and Brown place	675 00
Kellogg place	3,368 45

Loomis place	$415 00
Louisa Baker place	5,000 00
Market Garden Field Station	4,800 00
Mount Toby demonstration forest	30,000 00
Newell farm	2,800 00
Old creamery place	1,000 00
Owen farm	5,000 00
Pelham quarry	500 00
Tillson farm	2,950 00
Westcott place	2,250 00
	$144,938 08

College Buildings (Estimated Value) 1923.

	Inventory at Beginning of Year.	Per Cent deducted.	Value at Beginning of Year less Deterioration.	Repairs and Improvements during Year.	Total Value at Close of Fiscal Year.
Adams Hall	$127,604 51	2	$125,052 42	$757 48	$125,809 90
Apiary	2,884 82	2	2,827 13	–	2,827 13
Cashier's House	1,675 99	5	1,592 19	553 64	2,145 83
Chemistry Store House	50 00	2	49 00	55	49 55
Clark Hall	61,066 59	2	59,845 26	360 43	60,205 69
Cold Storage Laboratory	10,375 39	2	10,168 32	4 30	10,172 62
Dairy barn and storage	30,162 98	3	29,258 09	103 40	29,361 49
Draper Hall	69,615 10	3	67,526 65	4,445 02	71,971 67
Drill Hall and Gun Shed	9,183 03	5	8,723 88	499 64	9,223 52
Durfee Glass House, old	7,298 59	5	6,933 66	362 63	7,296 29
Durfee Glass House, new	10,464 50	5	9,441 27	805 89	10,247 16
Farm blacksmith shop	431 06	3	418 13	–	418 13
Farm bungalow	2,509 37	3	2,434 09	43 55	2,477 64
Farm House No. 1	3,097 06	3	3,004 15	192 47	3,196 62
Farm Bull pens and Fence	3,377 50	5	3,208 62	1,320 78	4,529 40
Fernald Hall	70,781 06	2	69,365 44	616 65	69,982 09
Flint Laboratory	68,856 08	2	67,478 96	2,101 62	69,580 58
French Hall	45,476 95	2	44,567 41	1,129 36	45,696 77
Grinnell Arena	8,741 11	2	8,566 29	62 06	8,628 35
Grounds Tool Shed	199 55	5	189 57	–	189 57
Harlow House	1,956 56	5	1,858 73	231 56	2,090 29
Horse Barn	4,655 80	3	4,516 13	110 95	4,627 08
Head of Division of Horticulture	2,486 60	5	2,362 27	399 07	2,761 34
Horticultural barn	3,655 43	3	3,545 77	216 05	3,761 82
Horticultural Garage	–	–	–	1,533 48	1,533 48
Horticultural tool shed	1,567 39	3	1,520 37	2,773 69	4,294 06
Horticultural open shed	469 35	5	445 88	–	445 88
Horticultural Manufactures shed	3,443 56	5	3,271 38	–	3,271 38
Hospital	15,477 99	2	15,168 43	258 45	15,426 88
Jewett house and barn	3,106 31	5	2,950 99	205 04	3,156 03
Machinery barn	3,331 69	3	3,231 74	110 46	3,342 20
Market Garden Field Station barn	3,024 29	3	2,933 56	–	2,933 56
Market Garden Field Station Foreman's Cottage	4,107 03	3	3,983 82	–	3,983 82
Market Garden Field Station Greenhouse Plant	9,002 44	5	8,552 32	–	8,552 32
Market Garden Field Station Wagon shed	507 02	3	491 81	–	491 81
Market Garden Field Station Administration Building	8,730 00	3	8,468 10	–	8,468 10
Market Garden Field Station Boiler House	5,645 40	3	5,476 04	–	5,476 04
Mathematical Building	4,538 37	5	4,311 46	83 44	4,394 90
Memorial Hall	103,486 14	2	101,416 42	716 60	102,133 02
Microbiology Building	56,243 44	2	55,118 57	359 02	55,477 59
Military Storage	203 62	5	193 44	–	193 44
Mount Toby House and Barn	3,312 00	5	3,146 40	256 23	3,402 63
North Dormitory	27,219 47	2	26,675 08	878 27	27,553 35
Physics Laboratory	4,797 18	5	4,557 32	77 48	4,634 80
Piggery	2,395 35	3	2,323 49	12 48	2,335 97
Poultry departments:					
No. 1, demonstration building	1,516 03	2	1,485 71	387 58	1,873 29
2, oil house	73 56	2	72 09	–	72 09
3, brooder, killing and fattening laboratory	2,315 10	2	2,268 80	–	2,268 80
4, mechanics, storage building and incubator cellar	3,969 67	2	3,890 28	259 31	4,149 59
5, laying house	1,632 01	2	1,599 37	150 91	1,750 28
6, manure shed	87 38	2	85 63	52 53	138 16
7, small henhouse	43 97	2	43 09	–	43 09

College Buildings, etc. — Concluded.

	Inventory at Beginning of Year.	Per Cent deducted.	Value at Beginning of Year less Deterioration.	Repairs and Improvements during Year.	Total Value at Close of Fiscal Year.
Poultry departments — *Con.*					
No. 8, breeding house	$1,445 29	2	$1,416 38	–	$1,416 38
9, experimental breeding house	546 25	2	535 32	$49 67	584 99
10, duck house	91 10	2	89 28	–	89 28
11, unit house for 200 hens	457 36	2	448 21	–	448 21
12, unit house for 100 hens	369 04	2	361 66	–	361 66
Power plant and storage building, including coal pocket	48,271 84	2	47,306 40	2,165 99	49,472 39
President's house	13,027 22	3	12,636 40	952 92	13,589 32
Rural engineering building	15,294 44	2	14,988 55	55 08	15,043 63
Sheep barn	1,343 03	3	1,302 74	6 04	1,308 78
South dormitory	40,358 38	2	39,551 21	1,400 55	40,951 76
Stable for calvary unit	18,149 31	3	17,604 83	151 98	17,756 81
Stockbridge Hall	164,430 81	2	161,142 19	973 60	162,115 79
Agronomy greenhouse	1,963 95	2	1,924 67	–	1,924 67
Stockbridge house	2,356 49	5	2,238 67	1 38	2,240 05
Stone Chapel	29,767 33	2	29,171 98	448 73	29,620 71
Turbine house	18,067 43	2	17,706 08	–	17,706 08
Vegetable plant house	4,365 31	5	4,147 04	1,106 29	5,253 33
Veterinary laboratory and stable	22,221 91	2	21,777 47	1,785 86	23,563 33
Waiting Station	507 27	2	497 12	5 99	503 11
Wilder Hall	33,085 64	2	32,423 93	87 75	32,511 68
Young stock barns	5,508 46	3	5,343 21	1,015 23	6,358 44
	$1,238,479 25	–	$1,209,228 36	$32,639 13	$1,241,867 49

College Equipment (Estimated Value).

Administrative division:	
Dean's Office	$1,256 35
President's Office	2,605 00
Registrar's Office	1,270 15
Treasurer's Office	5,196 82
Agricultural division:	
Agronomy	8,717 52
Animal Husbandry	1,014 87
Dairy	23,721 29
Farm	24,531 45
Farm Live stock	30,131 00
Farm Management	949 72
Freshman Agriculture	107 55
General Agriculture	2,401 12
Poultry	11,169 11
Rural engineering	7,225 75
Domestic science	3,891 41
Dining Hall	36,303 19
Extension	13,582 14
General science:	
Apiary	2,216 23
Botanical	25,087 55
Chemistry	17,017 14
Entomology	5,888 33
Mathematics	2,312 30
Microbiology	6,937 15
Physics	7,619 59
Veterinary	14,318 29
Zoölogy and Geology	17,092 94
Graduate School	117 45

Horticultural division:	
Floriculture	$33,178 42
Forestry	1,924 60
General Horticulture	7,598 03
Grounds	2,151 41
Horticulture Manufactures	5,414 75
Landscape Gardening	5,878 68
Market Garden Field Station	2,486 85
Mount Toby Reservation	297 21
Pomology	7,699 35
Vegetable Garden	4,252 58
Hospital	993 20
Humanities division:	
Economics and Sociology	199 70
Language and Literature	680 40
Library	132,663 80
Military	1,373 28
Operating and Maintenance:	
College supply	1,143 59
Fire Apparatus	1,534 50
General Maintenance:	
Office	822 82
Carpentry and Masonry Supplies	5,758 12
Carpentry and Masonry Tools	4,583 38
Electrical supplies	4,104 52
Electrical Tools	222 15
Electrical Commencement Supplies	619 75
Heating and Plumbing Supplies	10,598 01
Heating and Plumbing Tools	2,697 35
Painting Supplies	1,778 02
Painting Tools	227 03
Steam Main	54,511 10
Lighting Lines	9,904 30
Janitor's Supplies	1,283 30
Sewer Line	13,416 39
Water Mains	13,378 18
Power Plant	
General Equipment	106,485 45
Tools	337 35
Supplies	447 03
Fuel	23,648 75
Physical Education	1,839 82
Rural Social Science:	
Agricultural Economics	1,849 61
Agricultural Education	1,777 91
Rural Sociology	351 63
Short Course	2,033 44
Text Books	2,567 75
Trophy Room	1,200 00
Women's Dormitory	10,779 49
Memorial Hall	17,376 00
Totals	$776,750 41

Experiment Station Buildings (Estimated Value).

	Inventory at Beginning of Year.	Per Cent.	Cost at Beginning of Year less Per Cent Deterioration.	Repairs and Improvements during Year.	Total Value at Close of Year.
Agricultural laboratory	$14,535 21	2	$14,244 51	$77 66	$14,322 17
Agricultural barn	4,076 13	3	3,953 85	276 56	4,230 41
Agricultural farmhouse	1,610 53	3	1,562 21	96 26	1,658 47
Agricultural glasshouse	331 71	5	315 12	12 05	327 17
Brooks house	2,500 00	5	2,375 00	555 99	2,930 99
Brooks barn and sheds	1,500 00	5	1,425 00	–	1,425 00
Cranberry buildings	2,926 18	5	2,779 87	–	2,779 87
Entomological glasshouses	615 80	5	585 01	–	585 01
Plant and animal chemistry laboratory	27,380 73	2	26,833 12	363 52	27,196 64
Plant and animal chemistry barns	5,103 44	3	4,950 34	395 94	5,346 28
Plant and animal chemistry dairy	1,567 49	3	1,520 47	–	1,520 47
Six poultry houses	717 15	2	702 81	–	702 81
Tillson house	950 07	5	902 57	96 20	998 77
Tillson barn	928 54	5	882 11	–	882 11
Tillson poultry houses (4) Nos. 2, 3, 4, 5	2,749 75	2	2,694 75	259 29	2,954 04
Tillson incubator cellar No. 1	713 50	2	699 23	21 36	720 59
Tillson summer sheds (3) No. 6	–	–	–	276 96	276 96
Tillson pullet brooder No. 7	–	–	–	1,091 26	1,091 26
Tillson Hen Brooder No. 8	–	–	–	1,174 46	1,174 46
	$68,206 23		$66,425 97	$4,697 51	$71,123 48

Experiment Station Equipment.

	Estimated Value.
Apiary	$147 56
Agricultural Economics Department	415 92
Agricultural Laboratory	8,824 48
Agronomy Department	187 50
Botanical Laboratory	7,368 83
Chemical Laboratory	26,822 52
Cranberry Station	3,868 58
Director's Office	5,179 59
Entomological Laboratory	24,325 70
Meteorological Laboratory	778 00
Microbiological Laboratory	3,256 45
Pomology	4,582 72
Poultry Department	6,987 90
Treasurer's Office	982 67
Veterinary	1,527 35
Total	$95,255 77

Summary.

Land	$144,938 08
College buildings	1,241,867 49
College equipment	776,750 41
Experiment Station buildings	71,123 48
Experiment Station equipment	95,255 77
Total	$2,329,935 23

	Acres.
College estate (area)	702.19
Cranberry Station, Wareham (area)	23.67
Market Garden Field Station, Lexington (area)	12.00
Mount Toby demonstration forest (area)	755.27
Rifle range	46.20
Pelham quarry	.50
Total acreage	1,539.83
Cornelia Warren estate[1]	50.00
	1,589.83

[1] This property was received from the trustees of the Cornelia Warren estate under date of March 29, 1923, but no appraisement made. The property being under lease until October 1, 1923.

Students' Trust Fund Account.

	Disbursements, Year ending Nov. 30, 1923.	Receipts, Year ending Nov. 30, 1923.	Balance on Hand.	Balance brought forward Dec. 1, 1922.
Athletics	$22,183 70	$21,486 94	−$401 70	$295 06
Dining Hall	92,079 30	88,918 41	−3,117 62	43 27
Keys	58 50	56 50	84 00	86 00
Students' deposits	49,264 53	46,916 71	12,518 25	14,866 07
Social Union	4,068 10	3,668 60	83 57	483 07
Textbooks	9,706 01	9,948 33	1,322 54	1,080 22
Athletic Field	–	–	169 70	169 70
Uniforms	4,757 80	6,133 54	4,871 04	3,495 30
Cow-Testing	18,513 92	18,508 22	2,214 64	2,220 34
Totals	$200,631 86	$195,637 25	$17,744 42	$22,739 03
Balance beginning fiscal year	–	22,739 03	–	–
Balance on hand Nov. 30, 1923	17,744 42	–	–	–
Totals	$218,376 28	$218,376 28	–	–

Condensed Operating Statement of the Dining Hall.

	Operating Charges.	Income.
1922.		
Dec. 1, Balance		$43 27
1923.		
Nov. 30, Total Disbursements	$92,079 30	–
Outstanding bills	2,992 17	–
Total collections	–	88,918 41
Accounts outstanding	–	1,465 17
Inventory	–	8,139 32
Balance	3,494 70	–
Totals	$98,566 17	$98,566 17

Endowment Fund.[1]

	Principal.	Income.
United States grant (5 per cent)	$219,000 00	$7,300 00
Commonwealth grant (3½ per cent)	142,000 00	3,313 32
	–	$10,613 32

Burnham Emergency Fund 1923.

	Market Value Dec. 1, 1923.	Par Value.	Income.
Two bonds American Telephone and Telegraph Company 4s, at $925	$1,850 00	$2,000 00	$80 00
Two bonds Power Corporation of N. Y. 6½s at $1,000	2,000 00	2,000 00	130 00
One United States Liberty Bond 4¼s $980	490 00	500 00	21 25
One bond Ohio Service Company 6s $990	495 00	500 00	30 00
	$4,835 00	$5,000 00	$261 25
Louisville Gas & Electric Company	–	–	17 50
Western Electric Company	–	–	49 72
Unexpected balance Dec. 1, 1922	–	–	492 06
	–	–	$820 53
Extra expense in transfer of bonds	–	–	30 47
	–	–	$790 06
Disbursements for fiscal year ending Nov. 30, 1923	–	–	696 97
Cash on hand Nov. 30, 1923	–	–	$93 09

Disbursements:

Boys Camp	$30 19
Legislature	596 78
Prizes	70 00
	$696 97

[1] This fund is in the hands of the State Treasurer, and the Massachusetts Agricultural College receives two-thirds of the income from the same.

Library Fund.

	Market Value Dec. 1, 1923.	Par Value.	Income.
Five bonds New York Central & Hudson River Railroad Company 4s at $890	$4,450 00	$5,000 00	$200 00
Five bonds Lake Shore & Michigan Southern Railroad Company 4s at $940	4,700 00	5,000 00	200 00
Two shares New York Central & Hudson Railroad Company stock at $104	208 00	200 00	12 00
Amherst Savings Bank, deposit	167 77	167 77	7 59
	$9,525 77	$10,367 77	$419 59
Disbursements for fiscal year Nov. 30, 1923	–	–	419 59

Special Funds.

Endowed Labor Fund (the Gift of a Friend of the College).

Two bonds American Telephone and Telegraph Company 4s at $925	$1,850 00	$2,000 00	$80 00
Two bonds Lake Shore & Michigan Southern Railroad Company 4s at $940	1,880 00	2,000 00	80 00
One bond New York Central Railroad Gold Debenture 4s	890 00	1,000 00	40 00
One Bond Ohio Service Company 6s	990 00	1,000 00	60 00
Amherst Savings Bank, deposit	143 39	143 39	6 49
One United States Liberty Bond 4½s	980 00	1,000 00	42 50
	$6,733 39	$7,143 39	$308 99
Unexpended balance Dec. 1, 1922	–	–	330 31
Louisville Gas & Electric Company	–	–	35 00
	–	–	$674 30
Extra expense in transfer of bonds	–	–	9 67
Cash on hand Nov. 30, 1923	–	–	$664 63

Whiting Street Scholarship Fund.

One bond New York Central Railroad Gold Debenture 4s	$890 00	$1,000 00	$40 00
Amherst Savings Bank, deposit	271 64	271 64	12 32
	$1,161 64	$1,271 64	$52 32
Unexpended balance Dec. 1, 1923	–	–	555 65
Cash on hand Nov. 30, 1923	–	–	$607 97

Hills Fund.

Two United States Liberty Bonds 4¼ at $980	$1,960 00	$2,000 00	$85 00
One bond American Telephone and Telegraph Company 4s at $925	925 00	1,000 00	40 00
One bond New York Central & Hudson River Railroad Debentures, 4s at $890	890 00	1,000 00	40 00
One bond New York Central Railroad Debenture 4s at $900	900 00	1,000 00	40 00
Three bonds Pacific Telephone & Telegraph Company 5s at $970	2,910 00	3,000 00	150 00
One Penn. Public Service Corporation 6s	1,000 00	1,000 00	60 00
Boston & Albany Railroad Stock 3 5/8 shares at $150	544 00	362 00	31 68
Amherst Savings Bank, deposit	72 75	72 75	3 28
Electric Securities Company bonds 1 9/50 bonds at $950	1,121 00	1,180 00	59 00
Two bonds Great Western Light & Power Company 6s at $1000	2,000 00	2,000 00	120 00
	$12,322 75	$12,614 75	$628 96
Unexpended balance Dec. 1, 1922	–	–	1,918 82
Louisville Gas & Electric Company	–	–	70 00
Western Electric Company	–	–	24 86
	–	–	$2,642 64
Extra expense in transfer of bonds	–	–	26 17
	–	–	$2,616 47
Disbursements for fiscal year ending Nov. 30, 1923	–	–	276 99
Cash on hand Nov. 30, 1923	–	–	$2,339 48

Mary Robinson Fund.

Amherst Savings Bank deposit	$142 00	$142 00	$6 45
Boston & Albany Railroad stock, 3/8 share at $150	56 00	38 00	3 32
Electric Securities Company bonds 41/50 bond at $950	779 00	820 00	41 00
	$977 00	$1,000 00	$50 77
Unexpended balance Dec. 1, 1922	–	–	444 61
	–	–	$495 38
Disbursements for loans made to students from the D. K. Bangs fund and unpaid	–	–	305 00
Cash on hand Nov. 30, 1923	–	–	$190 38

Grinnell Prize Fund.

	Market Value Dec. 1, 1923.	Par Value.	Income.
Ten Shares New York Central & Hudson River Railroad stock at $104	$1,040 00	$1,000 00	$60 00
Unexpended balance Dec. 1, 1922	–	–	245 74
	$1,040 00	$1,000 00	$305 74
Disbursements for Prizes	–	–	50 00
Cash on hand Nov. 30, 1923	–	–	$255 74

Students' Loan Fund of the Massachusetts Agricultural Club.

First National Bank	$500 00	$500 00	–
Total Loans to students	–	300 00	–
	–	–	$200 00
Amount of Loans paid by students	–	–	50 00
Balance on hand Nov. 30, 1923.	–	–	$250 00

Gassett Scholarship.

One bond New York Central & Hudson River Debenture 4s at $890	$890 00	$1,000 00	$40 00
Amherst Savings Bank Deposit.	11 64	11 64	48
	$901 64	$1,011 64	$40 48
Unexpended balance Dec. 1, 1922	–	–	425 78
Cash on hand Nov. 30, 1923	–	–	$466 26

Massachusetts Agricultural College (Investment).

One share New York Central & Hudson River Railroad stock	$104 00	$100 00	$6 00
Unexpended balance Dec. 1, 1922	–	–	110 45
Cash on hand Nov. 30, 1923	–	–	$116 45

Danforth Keyes Bangs Fund.

Two bonds Pacific Telephone and Telegraph Company 5s at $970	$1,940 00	$2,000 00	$100 00
Two bonds Union Electric Light and Power Company 5s at $940	1,880 00	2,000 00	100 00
Two bonds American Telephone and Telegraph Company 4s at $925	1,850 00	2,000 00	80 00
One United States Liberty Bond 4¼s	980 00	1,000 00	42 50
Interest from student loans	–	–	117 41
	$6,650 00	$7,000 00	$439 91
Overdraft Dec. 1, 1922	–	–	−12 35
	–	–	$427 56
Total loans made to students during fiscal year $2,670.00	–	–	–
Cash received on account of students loans $3,615.00	–	–	–
Excess of cash received over loans made	–	–	945 00
Cash on hand Nov. 30, 1923	–	–	$1,372 56

John C. Cutter Fund.

One bond Pacific Telephone & Telegraph Co. 5s	$970 00	$1,000 00	$50 00
Unexpended balance Dec. 1, 1922	–	–	66 43
	$970 00	$1,000 00	$116 43
Disbursements for fiscal year ending Nov. 30, 1923	–	–	44 60
Cash on hand Nov. 30, 1923	–	–	$71 83

William R. Sessions Fund.

One bond New York Central & Hudson River Railroad 6s at $1,050.	$525 00	$500 00	$30 00
Three United States Liberty Bonds, two at $1,000 and one at $500, 4¼ at $980	2,450 00	2,500 00	106 25
One bond Adirondack Light & Power Company 6s	990 00	1,000 00	60 00
One bond Southern Illinois Light & Power Company 6s	990 00	1,000 00	60 00
	$4,955 00	$5,000 00	$256 25
Unexpended balance Dec. 1, 1922	–	–	340 06
	–	–	$596 31
Disbursements for fiscal year ending Nov. 30, 1923	–	–	527 15
Cash on hand Nov. 30, 1923	–	–	$69 16

Alvord Dairy Scholarship Fund.

	Market Value Dec. 1, 1923.	Par Value.	Income.
One United States Liberty Bond 4¼	$980 00	$1,000 00	$42 50
One bond Southern Illinois Light & Power Company 7s	1,020 00	1,000 00	70 00
Two bonds Great Western Power Company 6s at $1,000	2,000 00	2,000 00	120 00
	$4,000 00	$4,000 00	$232 50
Unexpended balance Dec. 1, 1922	–	–	1,160 11
	–	–	$1,392 61
Disbursements for fiscal year ending Nov. 30, 1923	–	–	150 00
Cash on hand Nov. 30, 1923	–	–	$1,242 61

J. D. W. French Fund.

Two bonds Southern Illinois Light & Power Company 6s at $990	$1,980 00	$2,000 00	–
Two bonds Great Western Light & Power Company 6s at $1,000	2,000 00	2,000 00	$60 00
Four bonds Penn. Public Service Corporation 6s at $1,000	4,000 00	4,000 00	35 00
Two bonds Ohio Service Company 6s at $990	1,980 00	2,000 00	60 00
	$9,960 00	$10,000 00	$155 00
Balance of income on hand	–	–	667 70
	–	–	$822 70
Expense of purchasing bonds	–	–	45 56
	–	–	$777 14
Disbursements for fiscal year ending Nov. 30, 1923	–	–	30 75
Cash on hand Nov. 30, 1923	–	–	$746 39

Summary of Balance on Hand of the Income from Funds Held in Trust by the M. A. C.

Burnham Emergency Fund	$93 09
Endowed Labor Fund	664 63
Whiting Street Scholarship Fund	607 97
Hills Fund	2,339 48
Mary Robinson Fund	190 38
Grinnell Prize Fund	255 74
Gassett Scholarship Fund	466 26
Massachusetts Agricultural College — Investment Fund	116 45
Danforth Keyes Bangs Fund	1,372 56
John C. Cutter Fund	71 83
William R. Sessions Fund	69 16
Alvord Dairy Scholarship Fund	1,242 61
Massachusetts Agricultural Club Fund	250 00
J. D. W. French Fund	746 39
	$8,486 55
	250 00
	$8,236 55

I hereby certify that I have this day examined the Massachusetts Agricultural College Account, as reported by the Treasurer, Fred C. Kenney, for the year ending November 30, 1923. All bonds and investments are as represented in the Treasurer's report. All disbursements are properly vouched for, and all cash balances are found to be correct.

CHARLES A. GLEASON,
Auditor.

Jan. 2, 1924.

History of Special Funds.

Burnham Emergency Fund. — A bequest of $5,000. from T. O. H. P. Burnham of Boston made without any conditions. The Trustees of the College have used this fund in any cases of emergency where funds were not available. At present

the fund is intact and the income only has been used for such emergency matters as the Trustees have authorized. The fund now shows an investment of $5,000.00.

Library Fund. — The library of the college at the present time contains 71,349 volumes. The income from the fund raised by the alumni and others is devoted to its increase, and additions are made from time to time as the needs of the different departments require. Dec. 27, 1883, William Knowlton gave $2,000; Jan. 1, 1894, Charles L. Flint gave $1,000; in 1887, Elizus Smith of Lee, Mass., gave $1,315. These were the largest bequests and now amount to $10,000.00.

Endowed Labor Fund. — Gift of a friend of the college in 1901, income of which is to be used for the assistance of needy and deserving students, $5,000.00.

Whiting Street Scholarship Fund. — Gift of Whiting Street of Northampton, for no special purpose, but to be invested and the income used. This fund is now used exclusively for scholarship, $1,000.00.

Hills Fund. — Gift of Leonard M. and Henry F. Hills of Amherst, Mass., in 1867, to establish and maintain a botanic garden, $10,000.00.

Mary Robinson Fund. — Gift of Miss Mary Robinson of Medfield, in 1874, for scholarship, $1,000.00.

Grinnell Prize Fund. — Gift of Hon. Wm. Claflin, to be known as the Grinnell agricultural prize, to be given to the two members of the graduating class who may pass the best oral and written examination in theory and practice of agriculture, given in honor of George B. Grinnell of New York, $1,000.00.

Gassett Scholarship Fund. — Gift of Henry Gassett of Boston, the income to be used for scholarship, $1,000.00.

Massachusetts Agricultural College Investment Fund. — Investment made by vote of trustees in 1893 to purchase one share of New York Central & Hudson River Railroad stock. The income from this fund has been allowed to accumulate, $100.00.

Danforth Keyes Bangs Fund. — Gift of Louisa A. Baker of Amherst, Mass., April 14, 1909, the income thereof to be used annually in aiding poor, industrious, and deserving students to obtain an education in said college, $6,000.00.

John C. Cutter Fund. — Gift of Dr. John C. Cutter of Worcester, Mass., an alumnus of the college, who died in August, 1909, to be invested by the trustees, and the income to be annually used for the purchase of books on hygiene, $1,000.00.

Alvord Dairy Scholarship Fund. — Gift of Henry E. Alvord, who was the first instructor in military tactics, 1869–71, and a professor of agriculture, 1885–87, at this institution. The income of this fund is to be applied to the support of any worthy student of said college, graduate or postgraduate, who may be making a specialty of the study of dairy husbandry (broadly considered) with the intention of becoming an investigator, teacher or special practitioner in connection with the dairy industry, provided that no benefits arising from such fund shall at any time be applied to any person who then uses tobacco in any form, or fermented or spirituous beverages, or is known to have done so within one year next preceding, $4,000.00.

William R. Sessions Fund. — In accordance with the request of my deceased wife, Clara Markham Sessions, made in her last will, I bequeath to the trustees of the Massachusetts Agricultural College, Amherst, Mass., the sum of $5,000, it being the amount received by me from the estate of the said Clara Markham Sessions. The said $5,000 to be kept by the said trustees a perpetual fund, the income from which shall be for the use of the Massachusetts Agricultural College; and according to the further request of my deceased wife; made in her last will, this is to be known as the William R. Sessions fund, and is to be a memorial of William R. Sessions; and it is my special request that the said trustees shall make record of the fact that this fund came from the estate of my deceased wife Clara Markham Sessions, in accordance with her request made in her last will, $5,000.00.

J. D. W. French Fund. — The Bay State Agricultural Society gives to the trustees of the Massachusetts Agricultural College the sum of $10,000. and some $500. of accumulated interest, to be held by them and to be known as the J. D. W. French Fund. It is our desire as Mr. French was especially interested in Dairying and Forestry that the trustees use the income from this fund, so that in their judgment

it will do the greatest good to students in dairying and its allies, also Forestry, either as scholarships, loans, or prizes. We should prefer, however, that when it seems most advisable, the income be used to help pay the expense of a judging team to go from the Massachusetts Agricultural College to the National Dairy Show or National Livestock Show. Nathaniel I. Bowditch, Sec. & Treas., BAY STATE AGRICULTURAL SOCIETY. June 27, 1922. $10,000.00.

Massachusetts Agricultural College Fund. — The Massachusetts Agricultural Club gave $500. to be used as a scholarship fund to the Massachusetts Agricultural College to help out deserving students there, who intended seriously to go into agriculture, interest on loans not to be charged until after graduation, $500.00.

Total of special funds, $60,600.00.

FRED C. KENNEY, *Treasurer.*

PUBLIC DOCUMENT No. 31

MASSACHUSETTS AGRICULTURAL COLLEGE

CATALOGUE, 1923-1924

PUBLIC DOCUMENT No. 31

THE M. A. C. BULLETIN
AMHERST, MASSACHUSETTS

VOLUME XVI JANUARY, 1924 NUMBER I

PUBLISHED EIGHT TIMES A YEAR BY THE MASSACHUSETTS AGRICULTURAL COLLEGE: JAN., FEB., MARCH, MAY, JUNE, SEPT., OCT., NOV. ENTERED AT THE POST OFFICE, AMHERST, MASS., AS SECOND CLASS MATTER

THE SIXTY-FIRST ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE

PART II.—CATALOGUE OF THE COLLEGE FOR 1923-1924

Publication of this Document
approved by the
Commission on Administration and Finance

The Commonwealth of Massachusetts.

DEPARTMENT OF EDUCATION,
STATE HOUSE, BOSTON, October 26, 1923.

To the Honorable Senate and House of Representatives.

GENTLEMEN: — In accordance with the provisions of Section 32 of Chapter 30 of the General Laws, I transmit to you, herewith, for the use of the General Court, Part II of the Annual Report of the Massachusetts Agricultural College for the year ending November 30, 1923.

Respectfully yours,

PAYSON SMITH,
Commissioner of Education.

MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, MASS., November 30, 1923.

To the Commissioner of Education.

SIR: — On behalf of the trustees of the Massachusetts Agricultural College I have the honor to transmit herewith Part II of the sixty-first annual report of the trustees for the fiscal year ended Nov. 30, 1923, this being the catalogue of the college.

Respectfully yours,

KENYON L. BUTTERFIELD,
President.

CONTENTS.

Without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and mechanic arts in such manner as the legislatures of the states may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life. — *Act of Congress, July 2, 1862.*

This issue of the catalogue represents the status of the college for the current college year, with provisional announcement of courses of study and other matters for the year to follow. When deemed necessary, additional announcements are made in a supplementary bulletin, published in the spring.

The college reserves, for itself and its departments, the right to withdraw or change the announcements made in its catalogue.

CALENDAR.

1923-1924-1925.

REGULAR AND TWO-YEAR COURSES.

1923.

September 26, Wednesday, 1.30 P.M.	Fall term begins; assembly.
October 12, Friday	Holiday, Columbus Day.
November 28–December 3, Wednesday, 12 M.–Monday, 7.30 A.M.	Thanksgiving Recess.
December 21, Friday, 5 P.M.	Fall term ends.

1924.

January 2, Wednesday, 7.30 A.M.	Winter term begins; assembly.
February 22, Friday	Holiday, Washington's Birthday.
March 14, Friday, 5 P.M.	Winter term ends.
March 18, Tuesday, 7.30 A.M.	Spring term begins; assembly.
April 19, Saturday	Holiday, Patriots' Day.
May 30, Friday	Holiday, Memorial Day.
June 7–9, Saturday–Monday	Commencement.
June 19–21, Thursday–Saturday	Entrance examinations.
Sept mber 17–20, Wednesday–Saturday	Entrance examinations.
September 24, Wednesday, 1.30 P.M.	Fall term begins; assembly.
October 13, Monday	Holiday, Columbus Day.
November 26–December 1, Wednesday, 12 M.–Monday, 7.30 A.M.	Thanksgiving Recess.
December 19, Friday, 5 P.M.	Fall term ends.
December 30, Tuesday, 7.30 A.M.	Winter term begins; assembly.

1925.

February 23, Monday	Holiday, Washington's Birthday.
March 13, Friday, 5 P.M.	Winter term ends.
March 17, Tuesday, 7.30 A.M.	Spring term begins; assembly.
April 20, Monday	Holiday, Patriots' Day.
May 30, Saturday	Holiday, Memorial Day.
June 6–8, Saturday–Monday	Commencement.
June 18–20, Wednesday–Saturday	Entrance examinations.
September 23–26, Wednesday–Saturday	Entrance examinations.
September 30, Wednesday, 1.30 P.M.	Fall term begins; assembly.

Massachusetts Agricultural College.

History. — The Massachusetts Agricultural College was organized under the national land grant act of 1862. This legislation is also known as the Morrill act, the original bill having been framed by Justin Smith Morrill, Senator from Vermont, and its final enactment secured under his leadership. It provided that public lands be assigned to the several States and territories, the funds from the sale of which were to be used to establish and maintain colleges of agriculture and mechanic arts. The Massachusetts Agricultural College was among the first of these institutions established. When this act was passed the Massachusetts Institute of Technology was already organized, and the State of Massachusetts decided that the instruction in the mechanic arts should be at the institute, and that the new institution should confine its work to agriculture. On this account the Massachusetts Agricultural College has the unique distinction of being the only separate agricultural college in the country.

In 1863 the State of Massachusetts accepted the provisions of the Morrill act and incorporated the Agricultural College. The location at Amherst was selected only after long and careful study by the orginal Board of Trustees. The college was formally opened to students on the 2d of October, 1867, with a faculty of four teachers and with four wooden buildings.

The Massachusetts Legislature has granted money for the erection of practically all of the buildings now on the grounds. In view of the fact that the annual income from the original endowment has been only a few thousand dollars, it has been necessary for the State to assume large responsibility for the current expenses of the institution.

Organization. — The college is a State institution, serving in the Department of Education and as such is subject to the laws governing and the rules applying to all State departments and institutions. The work of the college is directed by a board of sixteen trustees. Four of these are ex-officio members, — the Governor of the State, the Commissioner of Education, the Commissioner of Agriculture and the president of the college. The other fourteen members are appointed by the Governor for terms of seven years each, or two each year. The immediate control of the institution is vested in the president of the college. The administrative officers, having supervision of the various departments of activity, are directly responsible to the president.

In carrying out its purpose the college has organized three distinct yet correlated types of work, — namely, research, resident instruction and extension service.

Research. — Massachusetts provided for the establishment of an agricultural experiment station in 1882. This station, though on the college grounds and supported by the State, was without organic connection with the college. Under an act of Congress, passed in 1887, an agricultural experiment station was established and supported as a department of the college. For a time, therefore, Massachusetts had two experiment stations at the college. In 1895 these were combined, and the station reorganized as a department of the college. It is now supported by funds from both the State and the Federal government. In 1906 the Federal government largely increased its support on condition that the money thus provided should be used only for research. The station now receives about four-fifths of its support from the State.

The station is under the direct supervision of the Board of Trustees; the chief officer is the director, who is responsible to the president. It is organized into a number of

departments, all co-operating toward the betterment of agriculture. In most cases the heads of these departments are heads of corresponding departments in the college.

Resident Instruction. — The college offers an education without tuition fee to any student who is a resident of Massachusetts and who meets the requirements for admission. Women are admitted on the same basis as are men. Students who are not residents of Massachusetts are required to pay a nominal tuition fee. The chief aim of the institution, through its resident instruction, is to prepare men and women for the agricultural vocations. The term "agricultural vocations" is here used in its broadest sense. Courses are offered which give efficient training in various agricultural pursuits, such as general farming, dairying, management of estates, poultry husbandry, fruit growing, market gardening, floriculture, landscape gardening and forestry. Students are also trained for investigation in many sciences underlying the great agricultural industry, for teaching in agricultural colleges and high schools, and for scientific work in chemistry, entomology, botany and microbiology.

Though training for the agricultural vocations is thus the chief concern of the college, students should find the course one that trains them admirably for pursuits in which the sciences are an essential preparation. The course of study aims also to combine an adequate general education with specialized technical and practical training.

Four-year Courses. — Twenty-nine teaching departments offer instruction in agriculture, horticulture, sciences, the humanities, rural social science and rural home making. A system of major courses permits the student to elect major work in one of sixteen departments, and to specialize in it and allied subjects for a period of two years. The degree of bachelor of science is granted on the satisfactory completion of the four years' work of collegiate grade.

Short Courses. — In order to extend the advantages of the institution to those men and women who cannot or do not care to take advantage of the four-year course, various short courses are offered. Chief among these are a two-year course in practical agriculture, a summer school of agriculture and country life, and a winter school of agriculture.

Graduate School. — The graduate school is organized to provide the necessary training for scientific leadership in agriculture and allied sciences. The degrees of master of agriculture, master of landscape architecture, master of science, doctor of agriculture and doctor of philosophy may be earned upon the completion of satisfactory study, research and thesis.

The Extension Service. — The Extension Service is the organized educational agency of the college which serves the people of the State other than resident students. Its function is to make available to Massachusetts citizens useful and practical information on agriculture and home economics which is developed by the experiment station or the United States Department of Agriculture, and which is taught by the college to resident students. It is the recognized agency of the United States Department of Agriculture for teaching those who cannot attend college, and is a cooperative effort by the Department of Agriculture, the Massachusetts Agricultural College, and the County Extension Services.

The Extension Service uses many methods of work, among which are the following:

Demonstrations.
Publications.
Correspondence Courses.
Lectures.
Exhibits.
Extension Schools.
Leader-training Groups.
Boys' and Girls' Clubs in Agriculture and Home Economics.
Agricultural News Letters.

Literature descriptive of these various services will be mailed on request. Information may also be secured from the county agricultural agents at the following addresses:

Berkshire County Extension Service, Howard Block, Pittsfield, Mass.
Bristol County Agricultural School, Segreganset, Mass.
Cape Cod Extension Service, Hyannis, Mass.
Essex County Agricultural School, Hathorne, Mass.
Franklin County Extension Service, Sheldon Block, Greenfield, Mass.
Hampden County Improvement League, 244 Main St., Springfield, Mass.
Hampshire County Extension Service, 59 Main St., Northampton, Mass.
Middlesex County Extension Service, 12 Moody St., Waltham, Mass.
Norfolk County Agricultural School, Walpole, Mass.
Plymouth County Extension Service, 106 Main St., Brockton, Mass.
Worcester County Extension Service, 11 Foster St., Worcester, Mass.

Location and Equipment. — The Agricultural College is located in the town of Amherst. The grounds comprise more than 650 acres, lying about a mile north of the village center. The college has also a demonstration forest of 755 acres, located 6 miles north of the campus. The equipment of the college, both in buildings and facilities for instruction, is excellent. Amherst is 97 miles from Boston, and may be reached by the Central Massachusetts division of the Boston & Maine Railroad, or by the Central Vermont Railroad. Electric car lines connect Amherst with Northampton, Holyoke and Springfield.

Military Drill. — By Federal law military drill is required of all regular students attending the Massachusetts Agricultural College.

THE TRUSTEES.

ORGANIZATION OF 1923.

MEMBERS OF THE BOARD.

	TERM EXPIRES
FRANK GERRETT of Greenfield	1924
HAROLD L. FROST of Arlington	1924
CHARLES H. PRESTON of Danvers	1925
CARLTON D. RICHARDSON of West Brookfield	1925
DAVIS R. DEWEY of Cambridge	1926
JOHN F. GANNON of Pittsfield	1926
ARTHUR G. POLLARD of Lowell	1927
GEORGE H. ELLIS of West Newton	1927
ELMER D. HOWE of Marlborough	1928
ATHERTON CLARK of Newton	1928
NATHANIEL I. BOWDITCH of Framingham	1929
WILLIAM WHEELER of Concord	1929
CHARLES A. GLEASON of North Brookfield	1930
JAMES F. BACON of Boston	1930

MEMBERS EX OFFICIO.

His Excellency Governor CHANNING H. COX, *President of the Board of Trustees.*
KENYON L. BUTTERFIELD, *President of the College.*
PAYSON SMITH, *State Commissioner of Education.*
ARTHUR W. GILBERT, *State Commissioner of Agriculture.*

OFFICERS OF THE TRUSTEES.

His Excellency Governor CHANNING H. COX of Boston, *President.*
CHARLES A. GLEASON of North Brookfield, *Vice-President.*
RALPH J. WATTS of Amherst, *Secretary.*
FRED C. KENNEY of Amherst, *Treasurer.*
CHARLES A. GLEASON of North Brookfield, *Auditor.*

STANDING COMMITTEES OF THE TRUSTEES.[1]

Committee on Finance.

CHARLES A. GLEASON, *Chairman.*
GEORGE H. ELLIS.
NATHANIEL I. BOWDITCH.
ARTHUR G. POLLARD.
CARLTON D. RICHARDSON.
ATHERTON CLARK.

Committee on Course of Study and Faculty.

WILLIAM WHEELER, *Chairman.*
ELMER D. HOWE.
JAMES F. BACON.
PAYSON SMITH.
DAVIS R. DEWEY.
JOHN F. GANNON.
ARTHUR W. GILBERT.

Committee on Farm.

NATHANIEL I. BOWDITCH, *Chairman.*
FRANK GERRETT.
GEORGE H. ELLIS.
ARTHUR W. GILBERT.
CARLTON D. RICHARDSON.

[1] The president of the college is ex-officio member of each committee.

Committee on Horticulture.

Harold L. Frost, *Chairman.*
Charles A. Gleason.
Elmer D. Howe.
Atherton Clark.
Charles H. Preston.

Committee on Experiment Department.

Charles H. Preston, *Chairman.*
Arthur W. Gilbert.
Arthur G. Pollard.
Harold L. Frost.
Carlton D. Richardson.

Committee on Buildings and Arrangement of Grounds.

George H. Ellis, *Chairman.*
Frank Gerrett.
William Wheeler.
James F. Bacon.
Charles H. Preston.
Atherton Clark.

Committee on Extension Service.

Elmer D. Howe, *Chairman.*
George H. Ellis.
Harold L. Frost.
Davis R. Dewey.
Nathaniel I. Bowditch.
John F. Gannon.
Arthur W. Gilbert.

Officers of the Institution.

As of Nov. 1, 1923.

OFFICERS OF GENERAL ADMINISTRATION.

Kenyon L. Butterfield, A.M., LL.D. . . . . President's House.
President of the College.

Henry S. Green, A.B., LL.D. . . . . Mount Pleasant.
Librarian of the College.

Philip B. Hasbrouck, B.Sc. . . . . 31 Fearing Street.
Registrar of the College.

Sidney B. Haskell, B.Sc. . . . . 2 Mount Pleasant.
Director of the Experiment Station.

Fred C. Kenney . . . . Mount Pleasant.
Treasurer of the College.

Edward M. Lewis, A.M. . . . . 35 South Pleasant Street.
Dean of the College.

Charles E. Marshall, Ph.D. . . . . 44 Sunset Avenue.
Director of the Graduate School.

Richard A. Mellen, B.Sc. . . . . 25 Fearing Street.
Field Agent.

John Phelan, A.M. . . . . Mount Pleasant.
Director of Short Courses.

Ralph J. Watts, B.Sc. . . . . 101 Butterfield Terrace.
Secretary of the College.

John D. Willard, B.A. . . . . 31 Lincoln Avenue.
Director of the Extension Service.

THE FACULTY OF INSTRUCTION.

Kenyon L. Butterfield, A.M., LL.D. . . . . President's House.
President of the College and Head of the Division of Rural Social Science.

Max F. Abell, B.Sc. . . . . North Amherst.
Assistant Professor of Farm Management.

George W. Alderman, B.A. . . . . North Pleasant Street.
Instructor in Physics.

Charles P. Alexander, Ph.D. . . . . 120 Pleasant Street.
Assistant Professor of Entomology.

Edgar L. Ashley, A.M. . . . . Amherst House.
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Roy C. Avery, M.Sc. . . . . 15 Spring Street.
Instructor in Microbiology.

Luther Banta, B.Sc. . . . . Sunset Avenue.
Assistant Professor of Poultry Husbandry.

Mary A. Bartley . . . . 50 Pleasant Street.
Instructor in Home Economics.

Arthur B. Beaumont, Ph.D. . . . . 51 Amity Street.
Professor of Agronomy and Head of Department.

Carl M. Bogholt, B.Sc. . . . . The Davenport.
Instructor in English.

Thomas Brady, Jr., Captain, Cavalry, U. S. A. . . . . Amherst House.
Assistant Professor of Military Science and Tactics.

Alexander E. Cance, Ph.D. . . . . 9 Fearing Street.
Professor of Agricultural Economics and Head of Department.

Morton H. Cassidy, B.Sc. . . . . The Apiary.
Assistant Professor of Beekeeping.

Joseph S. Chamberlain, Ph.D. . . . . Mount Pleasant.
Professor of Organic and Agricultural Chemistry.

Walter W. Chenoweth, M.Sc. . . . . North Amherst.
Professor of Horticultural Manufactures and Head of Department.

Orton L. Clark, B.Sc. . . . . 12 College Street.
Assistant Professor of Botany.

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Professor of Insect Morphology.

William H. Davis, Ph.D. . . . . 8 Allen Street.
Assistant Professor of Botany.

Llewellyn L. Derby . . . . 25 Taylor Street, Holyoke.
Instructor in Physical Education.

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Assistant Professor of Horticulture.

Brooks D. Drain, B.Sc. . . . . 50 Pleasant Street.
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Professor of Entomology, Head of Department, Chairman of Division of Science.

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Professor of Farm Management and Head of Department.

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Curry S. Hicks, B.Pd. . . . . The Davenport.
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Mrs. Curry S. Hicks,[1] . . . . The Davenport.
Instructor in Physical Education.

Dwight Hughes, Jr., Captain, Cavalry, U. S. A. . . . . The Davenport.
Assistant Professor of Military Science and Tactics.

---

[1] Temporary.

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[1] On leave of absence.

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Frank A. Waugh, M.Sc. . . . . Campus.
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Professor of Agricultural Education and Head of Department.
T. George Yaxis, M.Sc. . . . . Sunset Avenue.
Assistant Professor of Dairying.
Hubert W. Yount, M.Sc. . . . . 9 Fearing Street.
Instructor in Agricultural Economics.

——— ———
Professor of Animal Husbandry and Head of Department.

——— ———
Professor of Economics and Sociology and Head of Department.

THE EXPERIMENT STATION STAFF.

Kenyon L. Butterfield, A.M., LL.D. . . . . President's House.
President of the College.
Sidney B. Haskell, B.Sc. . . . . 2 Mount Pleasant.
Director.
James R. Alcock . . . . North Amherst.
Laboratory Assistant in Animal Nutrition.
Harry L. Allen . . . . 89 Main Street.
Laboratory Assistant in Chemistry.

[1] Temporary.

Paul J. Anderson, Ph.D. . . . . 25 Lincoln Avenue.
Research Professor of Botany.
John G. Archibald, B.Sc.Agr. . . . . North Amherst.
Assistant Research Professor of Chemistry.
John S. Bailey, M.Sc. . . . . 50 Pleasant Street.
Investigator in Pomology.
Alyn S. Ball . . . . 94 Main Street.
Laboratory Assistant in Botany.
Arthur B. Beaumont, Ph.D. . . . . 51 Amity Street.
Professor of Agronomy and Head of Department.
Arthur I. Bourne, B.A. . . . . 12 East Pleasant Street.
Assistant Research Professor of Entomology.
Alexander E. Cance, Ph.D. . . . . 9 Fearing Street.
Professor of Agricultural Economics and Head of Department.
Walter W. Chenoweth, M.Sc. . . . . North Amherst.
Professor of Horticultural Manufactures and Head of Department.
Orton L. Clark, B.Sc. . . . . 12 College Street.
Assistant Professor of Botany.
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Investigator in Agriculture.
William L. Doran, B.Sc. . . . . Lexington.
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F. Ethel Felton, B.A. . . . . The Davenport.
Editorial Assistant.
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Professor of Farm Management and Head of Department.
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Research Professor in charge of Cranberry Station.
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Professor of Animal Pathology and Head of Department of Veterinary Science and Animal Pathology.
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Professor of Poultry Husbandry and Head of Department.
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A. Vincent Osmun, M.Sc. . . . . 16 Northampton Road.
Professor of Botany and Head of Department.

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Meterologist.
Norman J. Pyle, V.M.D. . . . . 5 Dana Street.
Assistant Research Professor of Avian Pathology.
Ruby Sanborn, A.B. . . . . 45 Pleasant Street.
Investigator in Poultry Husbandry.
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Professor of Pomology and Head of Department.
Jacob K. Shaw, Ph.D. . . . . 5 Farview Way.
Research Professor of Pomology.
Victor A. Tiedjens, M.Sc. . . . . Lexington.
Assistant Research Professor of Vegetable Gardening.
Harold F. Tompson, B.Sc. . . . . Lexington.
In charge of Market Garden Field Station, Professor of Vegetable Gardening and Head of Department.
Anna M. Wallace, M.A. . . . . Inwood.
Curator, Department of Botany.
Harold E. Wilson . . . . 15 Phillips Street.
Laboratory Assistant in Pomology.
Frank A. Waugh, M.Sc. . . . . Campus.
Head of Division of Horticulture.
Harlan N. Worthley, M.Sc. . . . . Tillson Court.
Investigator in Entomology.

CONTROL SERVICE STAFF.

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Oliver S. Flint, B.Sc. . . . . 18 Nutting Avenue.
Analyst.
Henri D. Haskins, B.Sc. . . . . Easthampton.
Official Chemist, Fertilizer Control.
James T. Howard . . . . 7 Phillips Street.
Inspector.
Frank J. Kokoski, B.Sc. . . . . Northampton Road.
Analyst.
Hazel M. Parker . . . . North Amherst.
Analyst.
John J. Smith . . . . 9 Phillips Street.
Collector of Blood Samples.
Philip H. Smith, M.Sc. . . . . 102 Main Street.
Official Chemist, Feed Control.
Lewell S. Walker, B.Sc. . . . . 19 Phillips Street.
Assistant Official Chemist, Fertilizer Control.

EXTENSION SERVICE STAFF.

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Director.
John B. Abbott, M.Sc. . . . . 31 North Prospect Street.
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Frederick E. Cole, Jr., B.Sc. . . . . 8 Kellogg Avenue.
Assistant Extension Professor of Pomology.
William R. Cole . . . . 5 East Pleasant Street.
Assistant Extension Professor of Horticultural Manufactures.
George L. Farley, M.Sc. . . . . 61 Amity Street.
State Club Leader.
Clifford J. Fawcett, B.Sc. . . . . 7 Woodside Avenue.
Extension Professor of Animal Husbandry.
Robert D. Hawley, B.Sc. . . . . South Amherst.
Supervisor of Extension Schools and Exhibits.
William F. Howe . . . . North Amherst.
Assistant State Club Leader.
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Extension Professor of Dairying.

Robert J. McFall, Ph.D. . . . . 20 Spring Street.
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Assistant State Club Leader.
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Extension Instructor in charge of Poultry Club Work.
Sumner R. Parker, B.Sc. . . . . South Amherst.
Supervisor of County Agent Projects.
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Assistant Extension Professor of Home Economics.
Joseph F. Whitney, B.Sc., M.L.A. . . . . 83 Pleasant Street.
Assistant Extension Professor of Landscape Gardening.
——— ———
Extension Professor of Farm Management.
——— ———
Extension Editor and Supervisor of Correspondence Courses.
——— ———
Assistant Extension Professor of Home Economics.

THE LIBRARY STAFF.

Henry S. Green, A.B., LL.D. . . . . Mount Pleasant.
Librarian.
Ethel A. Green, A.M. . . . . Mount Pleasant.
Library Assistant.
Lena V. Chapman . . . . 77 South Pleasant Street.
Assistant in charge of circulation.
Katharine Powell . . . . 9 Amity Street.
Department Librarian.
Bessie M. Weymouth . . . . 87 Pleasant Street.
Cataloguer.

OTHER OFFICERS.

John K. Broadfoot . . . . 130 Pleasant Street.
Cashier.
Thomas F. Butterworth . . . . 3 Phillips Street.
Engineer.
Avis P. Christopher . . . . Infirmary.
Resident Nurse.
Lawrence S. Dickinson, B.Sc. . . . . 2 Farview Way.
Superintendent of Grounds.
Lulu Diether . . . . Draper Hall.
Manager of the Dining Hall.
Samuel C. Hubbard . . . . North Amherst.
Foreman, Department of Floriculture.
Clarence A. Jewett . . . . 112 Pleasant Street.
Superintendent of Buildings.
John J. Lee . . . . 38 Cottage Street.
Assistant to the Military Detail.
Mrs. Marie B. Marsh . . . . Abigail Adams House.
Matron.
William E. Martin . . . . 5 Phillips Street.
Laboratory Assistant, Department of Horticultural Manufactures.
Enos J. Montague, B.Sc. . . . . Campus.
Farm Superintendent.
Adelbert Sheffield . . . . North Amherst.
Superintendent of Dairy Manufactures.
Mrs. Florence Thomas . . . . Infirmary.
Matron.

STAFF EMPLOYED FOR WORK FOR FEDERAL BOARD FOR VOCATIONAL EDUCATION.

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Supervisor of Agricultural Projects.

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Department of Poultry Husbandry.

Eleanor F. Chase, B.Sc. . . . . Abigail Adams House.
Department of Chemistry.

Otto Degener, B.Sc. . . . . Clark Hall.
Department of Botany.

James Gibbard, Jr., B.S.A. . . . . Tillson Court.
Department of Microbiology.

Gerald M. Gilligan, B.Sc. . . . . One Acre.
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Julia P. Hodgdon, B.A. . . . . The Davenport.
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Department of Entomology.

Standing Committees of the Faculty.

1923–24.

Commencement.

Dean Lewis.
Treasurer Kenney.
Secretary Watts.
Mr. S. R. Parker.
Professor Thayer.

Course of Study.

President Butterfield.
Dean Lewis.
Professor Waugh.
Professor Fernald.
Professor Ostrander.
Professor Marshall.
Professor Chamberlain.
Professor Phelan.
Professor Foord.
Professor Welles.

Discipline.

Dean Lewis.
Professor Machmer.
Professor Phelan.
Professor Chenoweth.
Professor Hicks.

Employment.

Professor Judkins.
Treasurer Kenney.
Secretary Watts.
Professor Thayer.

Academic Activities Board.

Professor Machmer.
Mr. Worthley.

Entrance Examinations and Admission.

Professor Hasbrouck.
Professor Patterson.
Professor Osmun.
Professor Ashley.
Professor Machmer.

Health and Sanitation.

Professor Marshall.
Dean Lewis.
Treasurer Kenney.
Professor Hicks.
Miss Skinner.

Library.

Professor Marshall.
Professor Patterson.
Professor Cance.
Dr. Green.

Scholarship.

Professor Machmer.
Dean Lewis.
Professor Hasbrouck.
Assistant Professor Rand.
Professor Mackimmie.
Professor Patterson.
Professor Hicks.
Assistant Professor Torrey.
Assistant Professor Rice.

Student Life.

Professor Patterson.
Secretary Watts.
Professor Phelan.
Professor Sears.
Professor Mackimmie.
Professor Thayer.

Athletic Board.

Dean Lewis.
Professor Hasbrouck.
Professor Osmun.

ADMISSION.

A. Application for Admission.

Correspondence concerning admission should be addressed to the registrar.

Every applicant for admission to the college must be at least sixteen years old, and must present to the registrar proper testimonials of character, which, whenever possible, should come from the principal of the school at which the applicant has prepared for college. Candidates who desire to present themselves for examination in any subjects must make application to the college for such privilege at least one month before the date of the examination. Blanks for such application may be obtained by addressing the registrar of the college. All entrance credentials must be in the hands of the registrar before the applicant can matriculate.

B. Modes of Admission.

Students are admitted to the freshman class either upon certificate or upon examination. No *diploma* from a secondary school will be accepted.

Certificates. — The Massachusetts Agricultural College is affiliated with the New England College Entrance Certificate Board. Therefore certificates of admission will be accepted from schools approved by the Board. Certificates of admission will also be accepted from any Massachusetts school listed as class "A" by the State Department of Education, but not included in the approved lists of the New England College Entrance Certificate Board. Principals of schools in New England who desire the certificate privilege should address the secretary of the Board, Professor Frank W. Nicolson, Wesleyan University, Middletown, Conn. Certificates from schools outside of New England may be received if those schools are on the approved list of the leading colleges of the section in which the school in question is located.

The credentials of the Board of Regents of the State of New York are accepted as satisfying the entrance requirements of this college when offered subject for subject.

Certificates in order to be accepted must present in the prescribed and restrictive elective groups at least three of the necessary fourteen and one-half credits. It is to be understood, however, that responsibility for certification in either elementary French, elementary German, English 1 or English 2, Latin A, Greek A or algebra must be assumed by one school, if the candidate has received his preparation in any one subject named above in more than one school. Subjects lacking on certificate (except for the permitted number of conditions) must be made up at the time of the examinations for admission.

Blank forms for certification — sent to principals or school superintendents only — may be obtained on application to the registrar of the college.

Examinations. — The examination in each subject may be oral or written, or both. The standard required for passing an examination for admission is 65 per cent. Conditions to the amount of two units will be allowed.

Entrance examination for admission to the Massachusetts Agricultural College will be held at the following centers: —

In June	Amherst, Department of Physics building. Massachusetts Institute of Technology, Cambridge, Mass. Worcester, Horticultural Hall.
In September	Amherst, Department of Physics building.

Please note that September examinations are held in Amherst only.

Schedule for Entrance Examinations, June 19–21, inclusive, 1924. — The examinations in June will follow this schedule: —

First Day.

7.45 A.M.	Registration.[1]
8.00 A.M.	Plane geometry.
10.00 A.M.	Chemistry.
11.30 A.M.	Botany.
2.00 P.M.	Solid geometry.
4.00 P.M.	Physics.

Second Day.

8.00 A.M.	English 1 and 2.
11.00 A.M.	Algebra.
2.00 P.M.	History (ancient; medieval and modern; English; general; United States and civics).

Third Day.

8.00 A.M.	French, German, Spanish, required and elective.
1.00 P.M.	Latin, elementary, intermediate and advanced, and all one-half credit electives, except those already noted.

Schedule for Entrance Examinations in September. — In September, 1924, the examinations will be given September 17–20, inclusive, and will follow the order indicated below: —

First Day.

1.00 P.M.	Registration.[1]
1.15–5.00 P.M.	Greek, elementary and intermediate.

Second Day.

8.00 A.M.	Plane geometry.
10.00 A.M.	Chemistry.
11.30 A.M.	Botany.
2.00 P.M.	Solid geometry.
4.00 P.M.	Physics.

Third Day.

8.00 A.M.	English 1 and 2.
11.00 A.M.	Algebra.
2.00 P.M.	History (ancient; medieval and modern; English; general; United States and civics).

Fourth Day.

8.00 A.M.	French, German, Spanish, required and elective.
1.00 P.M.	Latin, elementary, intermediate and advanced, and all one-half credit electives, except those already noted.

C. Requirements for Admission.

The requirements for admission are based on the completion of a four-year high school course, or its equivalent, and are stated in terms of units. The term unit means the equivalent of at least four recitations a week for a school year.

Fourteen and one-half units must be offered for admission in accordance with the

[1] Candidates who have no examination at the time set for registration may register at the time of the first examination should they so desire.

entrance requirements as stated below. Entrance credits gained either by certificate or by examination will hold good for one year.

Entrance Requirements.

1. *Prescribed.* — The following units are prescribed: —

English 1	1½
English 2	1½
A foreign language	2
Algebra	1½
Plane geometry	1
	7½

2. *Restricted Electives.* — Three units to be selected from —

Science	1, 2 or 3
History (American history and civics included)	1, 2 or 3
A second foreign language	2 or 3
Additional work, in first foreign language	1 or 2

3. *Free Margin.* — Free margin of four units to consist of any substantial work (including agriculture, general science and a fourth year of English) for which credit of not less than one-half unit earned in one year is given toward a secondary school diploma.

Units presented in the free margin group are not to be offered by examination or by certificate, but presented by submitting a principal's statement to the effect that such units have been earned in a secondary school, and have been credited toward a diploma issued by such a school. Work offered in the free margin group must be completed with certificate grade.

4. One unit of history must be offered in either the restricted electives or the free margin.

5. If elementary algebra and plane geometry are counted as three units, the total requirement will be fifteen units.

6. Both the credits under the prescribed group and the restricted elective group must be presented either by certificate from an approved school or by examination, or by a combination of both.

The following is a list of subjects in which the entrance credits must be offered in the prescribed and restricted elective groups: —

Mathematics and Science.

Botany[1]	½ or 1
Chemistry[1]	1
Algebra	1½
Plane geometry	1
Solid geometry	½
Trigonometry	½
Physics[1]	1
Geology	½
Physical geography	½
Physiology	½
Zoölogy[1]	½

History.

Ancient	1
Medieval and modern	1
English	1
General	1
United States and civics	1

[1] Note-book required as part of the preparation will be credited as part of the examination.

English.

English 1	1½
English 2	1½

Foreign Language.

Elementary French	2
Elementary German	2
Elementary Spanish	2
Elementary Latin	2
Elementary Greek[1]	2
Intermediate French	1
Intermediate German	1
Intermediate Spanish	1
Intermediate Latin	1
Intermediate Greek[1]	1
Advanced French	1
Advanced German	1
Advanced Spanish	1
Advanced Latin	1

No applicant deficient in both algebra and plane geometry will be admitted.

PRESENTATION OF NOTE-BOOKS. — The keeping of a note-book is required as part of the preparation in those subjects indicated (see note 1, below).

Candidates presenting themselves for examination in such subjects must present at the same time the required note-book, properly certified by the principal. Candidates presenting such subjects on certificates should not present note-books, but their certificates must state that note-books have been satisfactorily completed.

D. Statement of Preparation Required for Admission.

Agriculture. — Entrance credit in agriculture is granted on the following basis: —

I. The Massachusetts Agricultural College accepts a maximum of four credits in agriculture from any secondary or county agricultural high school in Massachusetts offering work in that subject, provided evidence of such work having been done is submitted on a principal's statement, as is indicated in the "free margin" group.

II. In high schools organizing agricultural club work under the supervision and rules of the junior extension service of the college, one credit is granted for each full year of work performed under the following plan: —

Work of the Winter Term. — (*a*) The study of textbooks such as are suitable for secondary school instruction in agriculture.

(*b*) Course of Study: A general outline of suggested topics for study.

(*c*) Visits by a representative of the Massachusetts Agricultural College for observation, counsel and advice in regard to kind and amount of work being done in agriculture.

(*d*) Formation of an agricultural club with officers from among its own members, meeting once a month under local supervision of some one authorized to act for the school authorities.

Work of the Spring Term. — Same in general form as winter term.

Work of the Summer Term. — An approved project conforming to the rules of some one or more of the agricultural clubs of the junior extension service of the Massachusetts Agricultural College.

Work of the Fall Term. — (*a*) An exhibit of work.

(*b*) Reports and story of achievement submitted to the junior extension service of the college.

The maximum number of credits in agriculture is four.

Botany. — For one unit of credit in botany, the work outlined in the statement of requirements issued by the College Entrance Examination Board, or its equivalent,

[1] Examination in September only.

will be accepted. This work should occupy one school year and include laboratory and supplementary textbook study. For one-half unit of credit, work that covers the same ground but occupies half the time required for a full unit of credit will be accepted. These requirements are met by such texts as Stevens' "Introduction to Botany" and Bergin & Davis' "Principles of Botany." A note-book containing neat, accurate drawings and descriptive records forms part of the requirement for either the half-unit or the one-unit credit, and this note-book must be presented by all applicants for admission upon examination in this subject. The careful preparation of an herbarium is recommended to all prospective students of this college, although the herbarium is not required.

Chemistry. — The entrance examination in chemistry will cover the work outlined by the College Entrance Examination Board as preparatory for college entrance. In general, this consists of a year of high school chemistry from any standard textbook, with laboratory work on the properties of the common elements and their simpler compounds. No particular work is prescribed. The keeping of a note-book is required.

Students who do not take chemistry in the preparatory school begin the subject in college, and are required to do extra work during the first two terms, as outlined under chemistry, courses 1 and 2, page 74.

Mathematics. — (*a*) Required. — Algebra: The four fundamental operations for rational algebraic expressions; factoring, determination of highest common factor and lowest common multiple by factoring; fractions, including complex fractions; ratio and proportion; linear equations, both numerical and literal, containing one or more unknown quantities; problems depending on linear equations; radicals, including the extraction of the square root of polynomials and numbers; exponents, including the fractional and negative; quadratic equations, both numerical and literal; simple cases of equations with one or more unknown quantities that can be solved by the methods of linear or quadratic equations; problems depending upon quadratic equations; the binomial theorem for positive integral exponents, the formulas for the nth term and the sum of the terms of arithmetic and geometric progressions, with applications.

Plane Geometry: The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurement of the circle; the solution of numerous original exercises, including loci problems; applications to the mensuration of lines and plane surfaces.

(*b*) *Elective.* — Solid Geometry: The usual theorems and constructions of good textbooks, including the relations of planes and lines in space; the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangle; the solution of numerous original exercises, including loci problems; applications to the mensuration of surfaces and solids.

Plane Trigonometry: A knowledge of the definitions and relations of trigonometric functions and of circular measurements and angles; proofs of the principal formulas and the application of these formulas to the transformation of the trigonometric functions; solution of trigonometric equations, the theory and use of logarithms, and the solution of right and oblique triangles.

Physics. — To satisfy the entrance requirement in physics, the equivalent of at least one unit of work is required. This work must consist of both classroom work and laboratory practice. The work covered in the class-room should be equal to that outlined in Hall & Bergen's "Textbook of Physics" or Millikan & Gale; the laboratory work should represent at least thirty-five experiments involving careful measurements, with accurate recording of each in laboratory note-book. This note-book, certified by the instructor in the subject, must be submitted by each candidate presenting himself for examination in physics; credit for passing the subject will be

given on laboratory notes and on the examination submitted. Candidates entering on certificate will not be required to present note-books, but the principal's certification must cover laboratory as well as class-room work.

PHYSIOLOGY. — Hough & Sedgwick's "The Human Mechanism;" Martin's "The Human Body; Briefer Course."

ZOÖLOGY, PHYSICAL GEOGRAPHY, GEOLOGY. — The following suggestions are made concerning preparation for admission in the subjects named above: —

For physiography, Davis' "Elementary Physical Geography;" Gilbert & Brigham's "Introduction to Physical Geography." For zoölogy, textbooks entitled "Animals" or "Animal Studies," by Jordan, Kellogg and Heath; Linville & Kelley's "A Textbook in General Zoölogy." For geology, A. P. Brigham's "A Textbook of Geology" or Tarr's "Elementary Geology."

Applicants for examination in zoölogy are *required* to present certified laboratory note-books; applicants for examination in the other subjects are *advised* to present note-books, if laboratory work has been done. Good note-books may be given credit for entrance. Examination in these subjects will be general, in recognition of the different methods of conducting courses; but students will be examined on the basis of the most thorough secondary school courses.

HISTORY. — The required unit must be offered in either ancient history, medieval and modern history, English history, general history, or United States history and civics. Either one, two or three elective units in any of the historical subjects here named may be offered, provided that no unit be offered in the same subject in which the required unit has been offered.

Preparation in history will be satisfactory if made in accordance with the recommendations of the committee of seven of the American Historical Association, as outlined by the College Entrance Examination Board. The examination will require comparisons and the use of judgment by the candidate rather than the mere use of memory, and it will presuppose the use of good textbooks, collateral reading and practice in written work. Geographical knowledge may be tested by requiring the location of places and movements on outline maps.

To indicate in a general way the character of the text-book work expected, the texts of the following authors are suggested: Botsford, Morey or Myers, in ancient history (to 814 A.D.); Adams, West or Myers, in medieval history; Montgomery, Larned or Cheyney, in English history; Myers or Fisher, in general history; Fiske, together with MacLaughlin or Montgomery, in United States history and civics.

ENGLISH. — The study of English in school has two main objects, which should be considered of equal importance: (1) command of correct and clear English, spoken and written; (2) ability to read with accuracy, intelligence and appreciation, and the development of the habit of reading good literature with enjoyment.

(1) *Grammar and Composition* (One and One-half Units). — The first object requires instruction in grammar and composition. English grammar should ordinarily be reviewed in the secondary school; and correct spelling and grammatical accuracy should be rigorously exacted in connection with all written work during the four years. The principles of English composition governing punctuation, the use of words, sentences and paragraphs should be thoroughly mastered; and practice in composition, oral as well as written, should extend throughout the secondary school period. Written exercises may well comprise letter-writing, narration, description and easy exposition and argument. It is advisable that subjects for this work be taken from the student's personal experience, general knowledge and studies other than English, as well as from his reading in literature. Finally, special instruction in language and composition should be accompanied by concerted effort of teachers in all branches to cultivate in the student the habit of using good English in his recitations and various exercises, whether oral or written.

(2) *Literature* (One and One-half Units). — The second object is sought by means of two lists of books, headed, respectively, "Reading" and "Study," from which may be framed a progressive course in literature covering four years. In connection with both lists the student should be trained in reading aloud and encouraged to commit to memory some of the more notable passages both in verse and in prose. As an aid to literary appreciation, he is further advised to acquaint himself with the most important facts in the lives of the authors whose works he reads and with their place in literary history.

A. Books for Reading. — The aim of this course is to foster in the student the habit of intelligent reading and to develop a taste for good literature by giving him a first-hand knowledge of some of its best specimens. He should read the books carefully, but his attention should not be so fixed upon details that he fails to appreciate the main purpose and charm of what he reads.

The books provided for reading are arranged in the following groups, from each of which at least two selections are to be made, except that for any book in Group I a book from any other may be substituted.

GROUP I. CLASSICS IN TRANSLATION.

The "Old Testament," at least the chief narrative episodes in Genesis, Exodus, Joshua, Judges, Samuel, Kings and Daniel, together with the books of Ruth and Esther.
The "Odyssey," with the omission, if desired, of Books I–V, XV and XVI.
The "Æneid."
The "Odyssey" and the "Æneid" should be read in English translations of recognized literary excellence.

GROUP II. DRAMA.

Shakespeare: "Merchant of Venice," "As You Like It," "Julius Cæsar."

GROUP III. PROSE FICTION.

Dickens: "A Tale of Two Cities."
George Eliot: "Silas Marner."
Scott: "Quentin Durward."
Hawthorne: "The House of the Seven Gables."

GROUP IV. ESSAYS, BIOGRAPHY, ETC.

Addison and Steele: "The Sir Roger de Coverley Papers."
Irving: "The Sketch Book," selections covering about 175 pages.
Macaulay: "Lord Clive."
Parkman: "The Oregon Trail."

GROUP V. POETRY.

Tennyson: "The Coming of Arthur," "Gareth and Lynette," "Lancelot and Elaine," "The Passing of Arthur."
Browning: "Cavalier Tunes," "The Lost Leader," "How They Brought the Good News from Ghent to Aix," "Home Thoughts from Abroad," "Home Thoughts from the Sea," "Incident of the French Camp," "Herve Riel," "Pheidippides," "My Last Duchess," "Up at a Villa — Down in the City," "The Italian in England," "The Patriot," "The Pied Piper," "De Gustibus," "Instans Tyrannus."
Scott: "The Lady of the Lake."
Coleridge: "The Ancient Mariner."
Arnold: "Sohrab and Rustum."

B. Books for Study. — This part of the requirement is intended as a natural and logical continuation of the student's earlier reading, with greater stress laid upon form and style, the exact meaning of words and phrases, and the understanding of allusions.

The books provided for study are arranged in four groups, from each of which one selection is to be made.

GROUP I. DRAMA.

Shakespeare: "Macbeth," "Hamlet."

GROUP II. POETRY.

Milton: "L'Allegro," "Il Penseroso," "Comus."

Book IV of Palgrave's "Golden Treasury" (first series), with special attention to Wordsworth, Keats and Shelley.

GROUP III. ORATORY.

Burke: "Speech on Conciliation with America."

Washington's "Farewell Address," Webster's "First Bunker Hill Oration," and Lincoln's "Gettysburg Address."

GROUP IV. ESSAYS.

Macaulay: "Life of Johnson."

Carlyle: "Essay on Burns," with a brief selection from Burns' poems.

Examination. — However accurate in subject-matter, no paper will be considered satisfactory if seriously defective in punctuation, spelling or other essentials of good usage.

The examination will be divided into two parts, one of which will be on grammar and composition, and the other on literature.

In grammar and composition, the candidate may be asked specific questions upon the practical essentials of these studies, such as the relation of the various parts of a sentence to one another, the construction of individual words in a sentence of reasonable difficulty, and those good usages of modern English which one should know in distinction from current errors. The main test in composition will consist of one or more essays, developing a theme through several paragraphs; the subjects will be drawn from the books read, from the candidate's other studies and from his personal knowledge and experience quite apart from reading.

The examination in literature will include: —

(*a*) General questions designed to test such a knowledge and appreciation of literature as may be gained by fulfilling the requirements defined under "A, Reading," above.

(*b*) A test on the books prescribed for study, which will consist of questions upon their content and structure, and upon the meaning of such words, phrases and allusions as may be necessary to an understanding of the works and an appreciation of their salient qualities of style. General questions may also be asked concerning the lives of the authors, their works and the periods of literary history to which they belong.

FRENCH. — Elementary: The necessary preparation for this examination is stated in the description of the two-year course in elementary French recommended by the Modern Language Association, contained in the definition of requirements of the College Entrance Examination Board.

Third and fourth year French (elective subjects for admission). — For a third credit unit in French as an elective subject for entrance, the work heretofore described by the College Entrance Examination Board as "intermediate" is expected. For a fourth credit unit, the work described as "advanced" is expected.

No examination for a third unit in French will be given unless the candidate has presented elementary French on certificate, or has written the examination in elementary French.

No examination for a fourth credit in French will be given unless the candidate has presented both elementary and intermediate French upon certificate, or has written the examination in both elementary and intermediate French.

GERMAN. — Elementary: The entrance requirements in German conform to those of the College Entrance Examination Board for elementary German (the standard two-year requirements).

Third and fourth year German (elective subjects for admission). — For a third credit unit in German as an elective subject for entrance, when required units have been offered in German, the work heretofore described by the College Entrance Examination Board as "intermediate" is expected. For a fourth credit unit, the work described as "advanced" is expected.

No examination for a third unit in German will be given unless the candidate has presented elementary German upon certificate, or has written the examination in elementary German.

No examination for a fourth credit in German will be given unless the candidate has presented both elementary and intermediate German upon certificate, or has written the examination for both elementary and intermediate German.

Spanish. — Elementary: The necessary preparation for this examination is stated in the description of the two-year course in elementary Spanish recommended by the Modern Language Association, contained in the definition of requirements of the College Entrance Examination Board.

Third and fourth year Spanish (elective subjects for admission). — For a third credit unit in Spanish as an elective subject for entrance, the work heretofore described by the College Entrance Examination Board as "intermediate" is expected. For a fourth credit unit, the work described as "advanced" is expected.

No examination for a third unit in Spanish will be given unless the candidate has presented elementary Spanish on certificate, or has written the examination in elementary Spanish.

No examination for a fourth credit in Spanish will be given unless the candidate has presented both elementary and intermediate Spanish upon certificate, or has written the examination in both elementary and intermediate Spanish.

Greek. — *Elementary.* — Greek grammar and composition: Translation into Greek of short sentences illustrating common principles of syntax.

The examination in grammar and prose composition will be based on the first four books of Xenophon's "Anabasis."

Intermediate. — Homer's "Iliad," Books I and II (omitting Book II, 494 to end), and the Homeric forms, constructions, idioms and prosody.

Prose composition, consisting of continuous prose based on Xenophon, and other Attic prose of similar difficulty.

Translation of passages of Homer at sight.

The examinations in Greek, elementary and intermediate, will be given in September only.

Latin. — *Elementary.* — Two credit units will be allowed if satisfactory proficiency is shown (including grammar) in (*a*) the translation of a passage or passages taken from Cæsar's "Gallic War," covering at least four books, and (*b*) the translation of passages of Latin prose at sight.

Intermediate. — Cicero (third oration "Against Catiline" and the orations "For Archias" and "For Marcellus") and sight translation of prose.

Advanced. — Vergil (Æneid, II, III and VI) and sight translation of poetry.

E. Admission to Advanced Standing.

Candidates for admission to advanced standing, in addition to meeting the regular entrance requirements, must also pass examinations in those subjects already pursued by the class they desire to enter. To meet this requirement, a student transferring to this college from another college or university of recognized standing must present the following credentials: —

1. A letter of honorable dismissal from the institution with which he has been connected.

2. A statement or certificate of his entrance record.

3. A statement from the proper officer showing a complete record of his work while in attendance.

4. A marked catalogue showing the courses pursued.

5. A statement from the proper officer, giving the total number of credits required for graduation by the institution from which the applicant is transferring, and, of this total, the number that the applicant has satisfactorily completed at the time of transfer.

These credentials should be presented to the registrar. Applications will be judged wholly on their merits and the college may prescribe additional tests before accepting applicants or determining the standing to be granted them.

F. Other Information about Entrance.

1. The privileges of the college may be withdrawn from any student at any time if such action is deemed advisable. (It is immaterial whether the pupil has entered by certificate or by examination.)

2. The examination in each subject may be either oral or written, or both. The standard required for passing an entrance examination is 65 per cent.

3. To matriculate, candidates must offer twelve and one-half of the fourteen and one-half units required for admission, and will be conditioned in those subjects not passed. At least five and one-half credits must be in the prescribed group. No candidate deficient in both algebra and plane geometry will be admitted.

4. Examinations for the removal of entrance conditions will be held as follows: (1) First entrance condition examination during the first week of the second term. (2) Second entrance condition examination before the beginning of the period of final examinations of the second term, upon the payment of a fee of $5 to the treasurer.

5. Credits for entrance requirements, whether gained by certificate or by examination, will hold good for one year.

6. Examinations in part of the subjects required for entrance may be taken one year before entering college.

7. For information concerning expenses, scholarships, etc., see "General Information."

8. For information concerning admission to short courses, see "Short Courses."

9. Application for admission as a "Special Student" should be made to the Dean.

Courses of Instruction.

FRESHMAN YEAR.

Table of Freshman Subjects.

[The figures indicate the number of credit hours per week. Freshman credit is computed on the basis of total clock hours per week spent in class room and study. Groups A and B of each term are required of all Freshman men; groups A and C of all Freshman women; total required credit, 50. For details, see the following tables of the first, second, and third terms, and the description of the courses.]

First Term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
Agriculture 1	1	2	2	5
Chemistry 1	3	4	5	12
or				
Chemistry 4	2	4	4	10
English 1	3	-	5	8
Language 1 or 4 (French or German)	3	-	6	9
Mathematics 1 (Algebra)	4	-	6	10
Group B; for men:				
Military 1 (or Physical Education 7)	-	3	-	3
Activities (including Physical Education 1 and 2)[1]	-	-	-	5 or 3
Group C; for women:				
Rural Home Life 1	2	-	-	2
Activities (including Physical Education 4)[1]	-	-	-	6 or 4
	Total required credits, 50.			

[1] To be chosen from the groups of athletic and academic activities, including football, baseball, cross country, track, tennis, hiking, Glee Club chorus, orchestra, Collegian and Squib competition, and class debate.

Second Term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
Agriculture 2	1	2	2	5
Chemistry 2	3	4	5	12
or				
Chemistry 5	2	4	3	9
English 2	3	-	5	8
Language 2 or 5 (French or German)	3	-	5	8
Mathematics 2 (Higher Algebra)	3	-	4	7
or				
Mathematics 3 (Solid Geometry)	3	-	4	7
Mathematics 4 (Mensuration)	2	-	3	5
Group B; for men:				
Military 2 (or Physical Education 8)	-	3	-	3
Activities[1]	-	-	-	5 or 2
Group C; for women:				
Activities (including Physical Education 5)[1]	-	-	-	8 or 5
	Total required credits, 50.			

[1] To be chosen from the groups of athletic and academic activities, including basket ball, hockey, board track, boxing, wrestling, winter sports, skating, theory, Glee Club chorus, Glee Club, orchestra, club specials, dramatics, class debate, varsity debate, Collegian, Squib.

Third Term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
Agriculture 3	1	2	2	5
Botany 3	2	4	4	10
English 3	3	–	6	9
Language 3 or 6 (French or German)	3	–	6	9
Mathematics 5 (Trig.)	3	–	6	9
Group B; for men:				
Military 3 (or Physical Education 9)	–	3	–	3
Activities (including Physical Education 3)[1]	–	–	–	5
Group C; for women:				
Activities (including Physical Education 6)[1]	–	–	–	8
	Total required credits, 50.			

[1] To be chosen from the groups of athletic and academic activities, including baseball, track, football, tennis, hiking, theory, orchestra, dramatics, Burnham, Flint, Collegian, Squib.

SOPHOMORE YEAR.

Table of Sophomore Subjects.

[The figures indicate the number of credit hours per week. Sophomore credit is computed on the basis of total clock hours per week spent in class room and study. Groups A and B of each term are required of all Sophomore men; groups A and C, of all Sophomore women. In addition, one of the "Divisional Elective Groups" is to be elected as a unit by each Sophomore; total required credit, 50. For details, see the following tables of the first, second, and third terms, and the description of the courses.]

First Term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
Botany 25	1	4	2	7
English 25	2	–	4	6
English 28	1	–	2	3
Physics 25	3	2	4	9
Group B; for men:				
Military 25 (or Physical Education 30)	–	3	–	3
Activities (including Physical Education 25)[1]	–	–	–	5
Group C; for women:				
Rural Home Life 25	1	2	–	3
Activities (including Physical Education 27)[1]	–	–	–	5
Divisional Elective Groups.				
Agriculture:				
Animal Husbandry 25	1	4	3	8
Agronomy 25	3	4	2	9
Horticulture:				
Horticulture 25	1	4	4	9
Drawing 25	–	8	–	8
Science:				
Modern Language (French or German)	3	–	5	8
Chemistry 25	1	4	4	9
Rural Social Science:				
American Government 25	3	–	5	8
Economics 25	3	–	6	9
	Total required credits, 50.			

[1] To be chosen from the groups of athletic and academic activities, including football, baseball, tennis, cross country, track, hiking, out-door basket ball, theory, Glee Club chorus, orchestra, Collegian, Squib, and Index competition, Collegian, and Squib.

Second Term.

The following table indicates the general plan of the Sophomore curriculum for the second term. The descriptions of second-term Sophomore courses in the body of the catalog have been left as for the year 1922–23, pending revision. Definite details of courses and credit will be announced before the beginning of the new term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
English				
Zoölogy				
Group B; for men:				
Military (or Physical Education)				
Activities				
Group C; for women:				
Agricultural Education				
Activities (including Physical Education)				
Divisional Elective Groups.				
Agriculture:				
Animal Husbandry				
Chemistry				
Physics				
Horticulture:				
Horticulture				
Drawing				
Agriculture Economics				
Science:				
Modern Language (French or German)				
Physics				
Chemistry				
Rural Social Science:				
Agricultural Economics				
American Education				
Animal Husbandry				
Landscape Gardening:				
Horticulture				
Mathematics				
Drawing				
	Total required credits,			

Third Term.

The following table indicates the general plan of the Sophomore curriculum for the third term. The descriptions of third-term Sophomore courses in the body of the catalog have been left as for the year 1922–23, pending revision. Definite details of courses and credit will be announced before the beginning of the new term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
English				
Citizenship				
Group B; for men:				
Military (or Physical Education)				
Activities (including Physical Education)				
Group C; for women:				
Rural Home Life				
Activities (including Physical Education)				
Divisional Elective Groups.				
Agriculture:				
Animal Husbandry				
Agronomy				
Rural Engineering				
Horticulture:				
Horticulture				
Agronomy				
Physics				
Science:				
Modern Language (French or German)				
Physics				
Entomology				
Rural Social Science:				
Rural Sociology				
Agronomy				
Entomology				
Landscape Gardening:				
Horticulture				
Mathematics				
Drawing				
	Total required credits,			

MAJORS: JUNIOR AND SENIOR YEARS.

General Statement.

A major consists of 45 credit hours of correlated work, which is arranged by the student and his adviser.

The list of courses found under each major on subsequent pages should not be considered as necessarily a rigid program to be followed. The heads of departments have suggested this series of courses as the best for the average man majoring in their departments. Advisers may, however, make modifications to suit the particular needs of the student, provided these modifications conform precisely to the class schedule as published for the year.

Rules governing Majors.

Rule 1. *Election.* — Each student, before the first term of his junior year, shall elect a major subject from the list of majors given below; and this major shall consist of 45 credit hours of correlated work.

Rule 2. *Minimum Credits.* — The minimum number of credits for graduation shall be 237 credit hours, inclusive of military drill and physical education.

Rule 3. *Maximum Credits.* — The maximum number of credits for any term of the junior or senior year shall be 22; the minimum shall be 19.

Rule 4. *Humanities and Rural Social Science.* — A minimum of 18 credit hours in the Divisions of the Humanities and Rural Social Science will be required of all students during their junior and senior years, with the following restriction: that a minimum of 5 credit hours will be required in each of the divisions.

Rule 5. *Advisers.* — The work of each junior and senior will be under the immediate supervision of an instructor designated as major adviser. Ordinarily, the major adviser will be the head of the department in which the student elects his major. The adviser has full authority to prescribe the student's work up to 45 hours. He will, however, so far as practicable, recognize the individual needs of the student. It is also expected that students will seek the counsel of the adviser with respect to the remaining courses required for graduation.

Rule 6. *Free Electives.* — Each student during his junior and senior years is required to take 45 hours in his major and also 18 hours in the Divisions of the Humanities and Rural Social Science, making a total of 63 hours (but see Rule 4). He is allowed free choice of courses to complete his required hours.

Rule 7. *Registration.* — No junior or senior shall register until his major course of study is approved by his adviser.

(1) Course cards for recording the election of majors will be issued from the Schedule Room five weeks before the close of each term.

(2) This card must be submitted by each student to his major adviser, who will lay out the course for the succeeding term and countersign the card.

(3) Each course card must be filled out, giving the name of student, his major, his class and the name and address of parent or guardian. When the major courses have been entered on this card, and the hours of free elections added by the student, the card, accompanied by one hour plan, must be returned to the Schedule Room two weeks before the beginning of the final examination period.

Rule 8. *Change of Major.* — Applications for change of major may be made to the dean in writing at any time; when approved by both major advisers concerned and by the dean and the committee on scholarship, they become operative at the beginning of the term following, provided that no change in the selection of a major may be made by any student after registration day of his senior year.

AGRONOMY. (Major.)

Professor ARTHUR B. BEAUMONT, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agronomy	50 **I.**	5
Agronomy	51 **III.**	3
Agronomy	75 **I.**	5
Agronomy	77 **II.**	5
Agronomy	78 **II.**	3
Animal Husbandry	50 **I.**	3
Chemistry	51 **I.**	8
Chemistry	52 **II.**	8
Farm Management	76 **I.**	3
Farm Management	77 **III.**	3
		43

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Animal Husbandry 25	8	Agronomy 50	5	Agronomy 75	5
	Agronomy 25	9	Chemistry 51	8	Farm Management 76	3
			Animal Husbandry 50	3		
II.	To be announced.		Chemistry 52	8	Agronomy 77	5
					Agronomy 78	3
III.	To be announced.		Agronomy 51	3	Farm Management 77	3

ANIMAL HUSBANDRY. (Major.)

Professor —— ——, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agronomy	50 **I.**	5
Animal Husbandry	50 **I.**	3
Animal Husbandry	51 **II.**	3
Animal Husbandry	52 **III.**	3
Animal Husbandry	53 **III.**	3
Animal Husbandry	75 **I.**	3
Animal Husbandry	78 **II.**	3
Animal Husbandry	79 **III.**	3
Animal Husbandry	81 **II.**	1
Animal Husbandry	82 **III.**	1
Dairying	50 **I.**	5
Farm Management	75 **II.**	3
Farm Management	76 **I.**	3
Veterinary	50 **II.**	5
		44

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Animal Husbandry 25	8	Animal Husbandry 50	3	Animal Husbandry 75	3
	Agronomy 25	9	Agronomy 50	5	Farm Management 76	3
			Dairying 50	5		
II.	To be announced.		Animal Husbandry 51	3	Animal Husbandry 78	3
			Veterinary 50	5	Animal Husbandry 81	1
					Farm Management 75	3
III.	To be announced.		Animal Husbandry 52	3	Animal Husbandry 79	3
			Animal Husbandry 53	3	Animal Husbandry 82	1

DAIRYING. (Major.)

Professor HENRY F. JUDKINS, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Economics	53 **III.**	5
Animal Husbandry	50 **I.**	3
Animal Husbandry	81 **II.**	1
Animal Husbandry	82 **III.**	1
Chemistry	76 **I.**	5
Dairying	50 **I.**	5
Dairying	52 **II.**	2
Dairying	51 **III.**	5
Dairying	75 **II.**	5
Dairying	76 **III.**	5
Dairying	78 **I.**	2
Farm Management	75 **I.**	3
Microbiology	50 **I.**	5
Microbiology	51 **II.**	5
Microbiology	82 **I.**	5
Rural Engineering	52 **III.**	5
		62

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Animal Husbandry 25	8	Dairying 50	5	Chemistry 76	5
	Agronomy 25	9	Microbiology 50	5	Dairying 78	2
			Animal Husbandry 50	3	Microbiology 82	5
II.	To be announced.		Dairying 52	2	Animal Husbandry 81	1
			Microbiology 51	5	Dairying 75	5
					Farm Management 75	3
III.	To be announced.		Chemistry 30	5	Agricultural Economics 53	5
			Dairying 51	5	Animal Husbandry 82	1
			Rural Engineering 52	5	Dairying 76	5

Farm Management. (Major.)

Professor James A. Foord, *Adviser*.

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agronomy	50 **I.**	5
Animal Husbandry	50 **I.**	3
Animal Husbandry	51 **II.**	3
Animal Husbandry	53 **III.**	3
Dairying	50 **I.**	
or		
Dairying	77 **III.**	5
Farm Management	75 **II.**	3
Farm Management	76 **I.**	3
Farm Management	77 **III.**	3
Farm Management	78 **II.**	1
Farm Management	79 **III.**	1
Microbiology	50 **II.**	
or		
Microbiology	50 **III.**	5
Rural Engineering	75 **I.**	4
Rural Engineering	78 **III.**	5
		44

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Animal Husbandry 25	8	Agronomy 50	5	Rural Engineering 75	4
	Agronomy 25	9	Dairying 50 (or 77 **III**)	5	Farm Management 76	3
			Animal Husbandry 50	3		
II.	To be announced.		Animal Husbandry 51	3	Farm Management 75	3
			Microbiology 50	5	Farm Management 78	1
					Rural Engineering 78	5
III.	To be announced.		Microbiology 50	5	Farm Management 77	3
			Animal Husbandry 53	3	Farm Management 79	1
			Dairying 77	5	Farm Management 81	2

Additional Information. — Botany 26, Drawing 26, Entomology 26 and 27, Dairying 51, Forestry 58, Pomology 50, 51, 76 and 78, Rural Engineering 79, and Veterinary 75, 76 and 78 are suggested as additional courses for the student fitting himself for general agriculture.

POULTRY HUSBANDRY. (Major.)

Professor JOHN C. GRAHAM, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Economics	53 **III.**	5
Agronomy	50 **I.**	5
Animal Husbandry	50 **I.**	3
Farm Management	75 **II.**	3
Poultry Husbandry	50 **I.**	5
Poultry Husbandry	51 **II.**	5
Poultry Husbandry	52 **III.**	5
Poultry Husbandry	75 **I.**	3
Poultry Husbandry	76 **I.**	4
Poultry Husbandry	77 **II.**	5
Poultry Husbandry	79 **III.**	4
Veterinary Science	85 **I.**	3
Veterinary Science	86 **II.**	3
Veterinary Science	87 **III.**	3
		56

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Animal Husbandry 25	8	Agronomy 50	5	Poultry 75	3
	Agronomy 25	9	Animal Husbandry 50	3	Poultry 76	4
			Poultry 50	5	Veterinary 85	3
II.	To be announced.		Poultry 51	5	Farm Management 75	3
					Poultry 77	5
					Veterinary 86	3
III.	To be announced.		Agricultural Economics 53	5	Poultry 79	4
			Poultry 52	5	Veterinary 87	3

STRONGLY ADVISED. — Microbiology 50 I, Rural Engineering 52 III, Zoölogy 76 II.

FLORICULTURE.

Professor CLARK L. THAYER, *Adviser*.

[The heavy-faced type indicates the term in which the course is given.]

COURSE.	Number.	Credit.
Botany	50 **I.**	2
Botany	51 **II.**	2
Floriculture	50 **I.**	4
Floriculture	51 **II.**	4
Floriculture	52 **III.**	4
Floriculture	53 **I.**	4
Floriculture	55 **III.**	3
Floriculture	75 **I.**	3
Floriculture	76 **II.**	3
Floriculture	77 **III.**	3
Floriculture	79 **II.**	3
Floriculture	80 **III.**	3
Horticulture	50 **I.**	5
Horticulture	51 **III.**	5
		48

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Drawing 25	8	Floriculture 50	4	Floriculture 75	3
	Horticulture 25	9	Floriculture 53	4	Horticulture 50	5
			Botany 50	2		
II.	To be announced.		Floriculture 51	4	Floriculture 76	3
			Botany 51	2	Floriculture 79	3
III.	To be announced.		Floriculture 52	4	Floriculture 77	3
			Floriculture 55	3	Floriculture 80	3
					Horticulture 51	5

ADVISED. — The department advises all students who major in this subject to take Entomology 50 and Landscape Gardening 75.

Landscape Gardening. (Major.)

Professor Frank A. Waugh, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Floriculture	78 **III.**	3
Horticulture	50 **I.**	5
Horticulture	51 **III.**	5
Landscape Gardening	50 **I.**	5
Landscape Gardening	51 **II.**	4
Landscape Gardening	52 **III.**	5
Landscape Gardening	75 **I.**	3
Landscape Gardening	76 **I.**	4
Landscape Gardening	77 **III.**	4
Landscape Gardening	78 **I.**	3
or		
Landscape Gardening	79 **I.**	3
Landscape Gardening	80 **II.**	4
Landscape Gardening	81 **II.**	4
Landscape Gardening	82 **III.**	4
		56

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Drawing 25	8	Landscape Gardening 50	5	Landscape Gardening 75	3
	Horticulture 25	9	Horticulture 50	5	Landscape Gardening 76	4
					Landscape Gardening 78 or 79	3
II.	To be announced.		Landscape Gardening 51	4	Landscape Gardening 80	4
			Landscape Gardening 78 or 79	3	Landscape Gardening 81	4
III.	To be announced.		Landscape Gardening 52	5	Landscape Gardening 77	4
			Horticulture 51	5	Landscape Gardening 82	4
			Floriculture 55	3		

Additional Information. — Modifications may be permitted when they appear advisable.

POMOLOGY. (Major.)

Professor FRED C. SEARS, *Adviser*.

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Economics	53 **III.**	5
Agronomy	77 **II.**	5
Botany	50 **I.**	1–4
Horticultural Manufactures	75 **I.**	5
Horticultural Manufactures	76 **II.**	3
Pomology	50 **I.**	3
Pomology	51 **II.**	3
Pomology	52 **III.**	3
Pomology	54 **II.**	3
Pomology	75 **I.**	3
Pomology	76 **II.**	3
Pomology	77 **I.**	3
Pomology	78 **III.**	3
Pomology	80 **I.**	1
Pomology	81 **II.**	1
Pomology	82 **III.**	1
Rural Engineering	78 **III.**	5
		51–54

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Drawing 25	8	Botany 50	1–4	Horticultural Manuf. 75	5
	Horticulture 25	9	Pomology 50	3	Pomology 75	3
					Pomology 77	3
					Pomology 80	1
II.	To be announced.		Pomology 51	3	Agronomy 77	5
			Pomology 54	3	Horticultural Manuf. 76	3
					Pomology 76	3
					Pomology 81	1
III.	To be announced.		Pomology 52	3	Pomology 78	3
			Agricultural Economics 53	5	Pomology 82	1
					Rural Engineering 78	5

Vegetable Gardening. (Major.)

Assistant Professor Roy D. Harris, *Adviser*.

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agronomy	75 **I.**	5
Agronomy	77 **II.**	5
Botany	50 **I.**	2
Botany	51 **II.**	2
Vegetable Gardening	52 **II.**	5
Vegetable Gardening	53 **III.**	5
Vegetable Gardening	75 **I.**	5
Vegetable Gardening	76 **II.**	5
Vegetable Gardening	77 **III.**	5
		39

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Drawing 25	8	Agronomy 75	5	Vegetable Gardening 75	5
	Horticulture 25	9	Botany 50	2		
II.	To be announced.		Agronomy 77	5	Vegetable Gardening 76	5
			Botany 51	2		
			Vegetable Gardening 52	5		
III.	To be announced.		Vegetable Gardening 53	5	Vegetable Gardening 77	5

Economic Botany. (Major.)

Professor A. Vincent Osmun, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Botany	52 **I.**	3
Botany	53 **II.**	3
Botany	54 **III.**	3
Botany	55 **I.**	3
Botany	56 **II.**	3
Botany	75 **I.**	5
Botany	76 **II.**	5
Botany	77 **III.**	5
Botany	78 **I.**	5
Botany	79 **II.**	5
Botany	80 **III.**	5
Botany	82 **II.**	3
Botany	83 **III.**	3
Botany	86 **I.**	1
Botany	87 **II.**	1
Botany	88 **III.**	1
Chemistry	51 **I.**	8
		62

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Chemistry 25	9	Botany 52	3	Botany 75	5
	French or German 25 or 28[1]	8	Botany 55	3	Botany 78	5
			Chemistry 51	8	Botany 86	1
II.	To be announced.		Botany 53	3	Botany 76	5
			Botany 56	3	Botany 79	5
					Botany 82	3
					Botany 87	1
III.	To be announced.		Botany 54	3	Botany 77	5
					Botany 80	5
					Botany 83	3
					Botany 88	1

Selection of 45 credits of the above (Pathology 75, 76 and 77, Physiology 78, 79 and 80).

[1] German is advised.

Agricultural Chemistry. (Major.)

Professor Charles A. Peters, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Chemistry	51 **I.**	8
Chemistry	52 **II.**	8
Chemistry	62 **III.**	5
Chemistry	65 **III.**	5
Chemistry	76 **I.**	5
Chemistry	77 **II.**	5
Chemistry	80 **I.**	5
Chemistry	86 **II.**	3
Chemistry	87 **III.**	3
Chemistry	92 **II.**	3[2] (92, 94)
Chemistry	94 **II.**	
Chemistry	91 **III.**	5 (91, 93, 95)
Chemistry	93 **II.**	
Chemistry	95 **III.**	
		50[3]

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Chemistry 25	9	Chemistry 51	8	Chemistry 76	5
	French or German 25 or 28[1]	8			Chemistry 80	5
II.	To be announced.		Chemistry 52	8	Chemistry 77	3
					Chemistry 86	3
					Chemistry 92, 94	3
III.	To be announced.		Chemistry 62	5	Chemistry 87	3
			Chemistry 65	5	Chemistry 91, 93, 95	5

[1] A knowledge of German is required.

[2] Courses 92, 94 may be changed from 3 credits to an option of 3 or 5 credits. Students will select one course from groups 92, 94, and 91, 93, 95 respectively.

[3] Only 45 credits required.

Economic Entomology. (Major.)

Professor Henry T. Fernald, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Botany	50 **I.**	3
or		
Botany	52 **I.**	3
Entomology	50 **I.**	3
Entomology	52 **II.**	3
Entomology	53 **I.**	5
Entomology	54 **I.**	3
Entomology	55 **III.**	3
Entomology	75 **III.**	4
Entomology	76 **I.**	5
Entomology	77 **II.**	3
Entomology	78 **III.**	4
Entomology	90 **II.**	3
Zoölogy	50 **I.**	3
or		
Zoölogy	54 **II.**	3
or		
Chemistry	51 **I.**	8
		42 or 47

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Chemistry 25 French or German 25 or 28	9 8	Entomology 54 Entomology 53 Botany 50 or 52 Zoölogy 50 or Chemistry 51	3 5 3 3 8	Entomology 76 Entomology 85 Horticulture 50	5 3 5
II.	To be announced.		Entomology 52 Entomology 56 Microbiology 50 Pomology 79	3 3 5 3	Entomology 77 Entomology 90	3 3
III.	To be announced.		Entomology 55 Entomology 75 Entomology 65 Vegetable Gardening 50	3 4 5 3	Entomology 78 Horticulture 51 Pomology 78	4 5 3

The subjects (except Entomology) in the last two columns above are merely suggested as desirable to choose from.

Microbiology. (Major.)

Professor Charles E. Marshall, *Adviser*.

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Chemistry	51 **I.**	8
Chemistry	52 **II.**	8
Microbiology	50 **I.**	
or		5
Microbiology	50 **II.**	
or		
Microbiology	50 **III.**	
Microbiology	51 **II.**	5
or		
Microbiology	51 **III.**	
Microbiology	52 **III.**	5
Microbiology	81 **I.**	
or		
Microbiology	82 **I.**	5
or		
Microbiology	83 **III.**	
Microbiology	80 **II.**	
or		
Microbiology	75 **II.**	5
or		
Dairying	51 **III.**	
Microbiology	76 **III.**	5
		46

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Chemistry 25	9	Microbiology 50	5	Microbiology 81	5
	French or German 25 or 28	8	Chemistry 51	8	Microbiology 82	5
II.	To be announced.		Microbiology 51	5	Microbiology 75	5
			Chemistry 52	8	Microbiology 80	5
			Microbiology 50	5		
III.	To be announced.		Dairying 51	5	Microbiology 76	5
			Microbiology 50	5	Microbiology 83	5
			Microbiology 51	5		
			Microbiology 52	5		

Additional Information. — Mathematics 50, 51 and 52 are recommended.

Agricultural Economics. (Major.)

Professor Alexander E. Cance, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Economics	50 **I.**	5
Agricultural Economics	52 **II.**	5
Agricultural Economics	53 **III.**	5
Agricultural Economics	75 **II.**	3
Agricultural Economics	76 **II.**	5
Agricultural Economics	78 **III.**	5
Agricultural Economics	77 **I.**	
or		5
Agricultural Economics	79 **I.**	
Agricultural Economics	87 **III.**	3
Economic Sociology	51 **I.**	5
Economic Sociology	50 **II.**	5
Rural Sociology	51 **II.**	
or		3
Rural Sociology	52 **III.**	
		49

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Economic Sociology 25	9	Agricultural Economics 50	5	Agricultural Economics 77	5
	History and Gov't 25	8	Economic Sociology 51	5	Agricultural Economics 79	5
II.	To be announced.		Agricultural Economics 52	5	Agricultural Economics 76	5
			Economic Sociology 50	5	Agricultural Economics 75	5
			Rural Sociology 51	3		
III.	To be announced.		Agricultural Economics 53	5	Agricultural Economics 78	3
			Rural Sociology 52	3	Agricultural Economics 87	3

Agricultural Education. (Major.)

Professor Winthrop S. Welles, *Adviser*.

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Education	51 **I.**	5
or		
Agricultural Education	51 **II.**	5
Agricultural Education	52 **III.**	5
Agricultural Education	55 **I.**	5
Agricultural Education	56 **II.**	5
Agricultural Education	75 **II.**	3
Agricultural Education	76 **I.**	5
or		
Agricultural Education	76 **III.**	5
Agricultural Education	77 **III.**	3
Agricultural Education	80 **I.**	1-5
or		
Agricultural Education	80 **II.**	1-5
or		
Agricultural Education	80 **III.**	1-5
Agricultural Education	81 **III.**	1-2
Agricultural Education	83 **III.**	1-2
Agricultural Education	85 **I.**	3

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Economic Sociology 25	9	Agricultural Education 51	5	Agricultural Education 76	5
	History and Gov't 25	8	Agricultural Education 55	5	Agricultural Education 80	1-5
					Agricultural Education 85	3
II.	To be announced.		Agricultural Education 51	5	Agricultural Education 75	3
			Agricultural Education 56	5	Agricultural Education 80	1-5
III.	To be announced.		Agricultural Education 52	5	Agricultural Education 76	5
					Agricultural Education 77	3
					Agricultural Education 80	1-5

Advised. — (*a*) For general teaching program 51, 55, 56, 75 and 80 or their equivalents. (*b*) For teachers of agriculture and related subjects 51, 56, 76 and 80 or their equivalents. (*c*) For extension teaching 51, 55, 76, 77 and 80 or their equivalents.

Rural Sociology. (Major.)

Professor John Phelan, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Economics	50 **I.**	5
Agricultural Economics	52 **II.**	5
Agricultural Economics	53 **III.**	5
Agricultural Economics	75 **II.**	5
Economics and Sociology	51 **I.**	5
Economics and Sociology	50 **II.**	5
Economics and Sociology	75 **I.**	5
Economics and Sociology	77 **III.**	5
Rural Journalism	55 **III.**	3
Rural Sociology	50 **I.**	3
Rural Sociology	51 **II.**	3
Rural Sociology	52 **III.**	3
Rural Sociology	77 **II.**	3
Rural Sociology	79 **I.**	1-3
Rural Sociology	80 **II.**	1-3
Rural Sociology	81 **III.**	1-3
		58-64

Term.	Sophomore.	Credit.	Junior.	Credit.	Senior.	Credit.
I.	Economic Sociology 25	9	Economic Sociology 51	5	Agricultural Economics 50	5
	History and Gov't 25	8	Rural Sociology 50	3	Economic Sociology 75	5
					Rural Sociology 79	1-3
II.	To be announced.		Economic Sociology 50	5	Agricultural Economics 52	5
			Rural Sociology 51	3	Agricultural Economics 75	5
					Rural Sociology 77	3
					Rural Sociology 80	1-3
III.	To be announced.		Economic Sociology 77	5	Agricultural Economics 53	5
			Rural Journalism 55	3	Rural Sociology 81	1-3
			Rural Sociology 52	3		

Description of Courses.

DIVISION OF AGRICULTURE.

[Heavy-faced Roman numerals indicate the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

Freshman Agriculture.

1. **I.** A survey course, continuing throughout the year, intended to put the student in touch with agriculture in all its major aspects, dealing primarily with the problems of Massachusetts farms but not excluding the agriculture of the United States. One of the two study hours per week may be used for motion pictures.
1 class hour. 1 2-hour laboratory period, 2 study hours, credit, 5.
Professor Redman in co-operation with the Divisions of Agriculture and Horticulture.

2. **II.** As stated under Course 1 **I.**
1 class hour. 1 2-hour laboratory period, 2 study hours, credit, 5.

3. **III.** As stated under Course 1 **I.**
1 class hour. 1 2-hour laboratory period, 2 study hours, credit, 5.

Agronomy.

Professor Beaumont, Assistant Professor Michels, Mr. Thelin, Mr. Thayer, Mr. Lanphear.

The courses in agronomy are designed to present the fundamental knowledge concerning the soil and the principal products of the field. The basic course in soils is required of all students. The electives purpose to meet the needs of those specializing in soils and field crops and other specialized fields including both pure and applied science.

The laboratories for soils and fertilizers include one for elementary work, supplied with locker equipment for 200 students, and one for advanced work, accommodating 80 students. These laboratories are equipped with steam and electric ovens, balances, centrifuge, microscopes and other apparatus necessary for a study of soils and fertilizers. Storerooms, stock rooms, and balance rooms are conveniently near the laboratories. There is also a workroom attached, equipped with power machinery for grinding soils, fodders and the like.

The crops' laboratories include one for seed study, with lockers for 50 students, and a laboratory for the study of cereals, forage crops, roots, etc., with lockers for 64 students. The equipment of these laboratories includes steam ovens, constant temperature electric ovens, ovens for seed germination, Brown-Duval moisture apparatus, balances, microscopes, and collections of seeds, grasses, tubers, weeds, etc. A balance room, root cellar and two storerooms, one of which is mouse-proof, are also used for crop work.

A modern steam-heated greenhouse 25 by 35 feet, used for work in soils and crops, is a valuable part of the equipment. Near the greenhouse is a crop garden on which different varieties of corn, grasses, clovers, etc., are grown for demonstration purposes, and as a source of material for class work. In addition, the general college farm of 250 acres is used for field study in soils and crops, and as a source of material.

Required Courses.

25. **I.** Agronomy. — For sophomores. An introductory course designed to acquaint the student with the most important field crops and their production.
2 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 9.

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27. **III.** Soils and Fertilizers. — Sophomores. A study of soils and their properties, soil management, methods of soil improvement and maintenance of fertility, including the use of farm manures, commercial fertilizers and soil amendments.
4 class hours. 1 2-hour laboratory period, credit, 5.
Professor Beaumont and the Department.
Prerequisite, Freshman-required Chemistry.

Elective Courses.

50. **I.** Field and Forage Crops. — For juniors; seniors may elect. History, classification and production of corn and of those grasses, legumes, root and tuber crops suited to New England conditions. Crops of less importance in New England are briefly considered. The work includes lecture, laboratory and field study.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Assistant Professor Michels and Mr. Thelin.
Prerequisites, Agronomy 27, Botany 3.

51. **III.** Advanced Field Crops (1923–24). — For juniors; seniors may elect. Study of the cereals and other field crops not taken up or only briefly considered in Course 50. General problems of crop production are also considered, and the work is not entirely confined to New England conditions. The laboratory work includes a study of the cereals, the quality of seeds, grains and crop products, crop problems and field work with such crops as are available. Given in alternate years.
2 class hours. 1 2-hour laboratory period, credit, 3.
Assistant Professor Michels and Mr. Thelin.
Prerequisite, Agronomy 50.

75. **I.** Advanced Soils. — For seniors; juniors may elect. A field, lecture and laboratory course on soils and their adaptability to different uses. The field work consists of a detailed study of soil textures, natural and spontaneous vegetation and other factors which indicate the fertility and adaptation of the soil; accompanied by a laboratory study of the physical properties of the soils sampled.
2 class hours. 1 4-hour and 1 2-hour laboratory period, credit, 5.
Professor Beaumont and the Department.
Prerequisite, Agronomy 27. Advised, Geology 27.

77. **II.** Manures and Fertilizers. — Seniors. An advanced course, giving a general discussion of the different theories which have been held relative to the functions and importance of manures and fertilizers, and leading up to the views at present accepted. Considerable attention is devoted to consideration of the experimental work which has been done, and which is now in progress. The laboratory work consists of a study of fertilizers, fertilizer mixtures, limes and culture work.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Professor Beaumont and Mr. Lanphear.
Prerequisite, Agronomy 27. Advised, Chemistry 27.

78. **II.** Breeding of Field Crops (1924–25). — Seniors. Deals with the improvement, by selection and breeding, of the crops studied in Course 50. Given in alternate years.
2 class hours. 1 2-hour laboratory period, credit, 3.
Assistant Professor Michels.

Prerequisite, Agronomy 50.

Animal Husbandry.

Professor —— , Assistant Professor Rice, Assistant Professor Glatfelter, Mr. Thayer.

It is the purpose of this department to present comprehensive information on the subject of animal husbandry. The first courses are studies of the breeds, types and market classes of live stock. These are followed by courses in judging, breeding and management.

The department is equipped with an excellent laboratory, Grinnell Arena, which has a seating capacity of 180. The equipment for classroom instruction includes upwards of 125 head of dairy cattle which are superior representatives of Jersey, Guernsey, Ayrshire and Holstein breeds; considerable numbers of Berkshire and Chester White pigs; pure-bred Percherons; and several work teams of various types. The department has a collection of plaster of Paris models of individuals of foreign and domestic breeds of horses, cattle, sheep and swine; and a set of over 250 lantern slides portraying the leading prize-winning producing and breeding animals of the principal breeds of horses, cattle, sheep and swine. There is also a collection of the different foodstuffs available for the use of New England farmers. All this equipment is being added to from time to time as funds are available.

Elective Courses.

25. **I.** Livestock Judging and Market Classes of Farm Animals. — A study of the principles governing the selection of animals for market, feed lot, breeding, milk production and work, including the use of the score card and the comparative judging of the various types of livestock. Text book, Vaughn's Types and Market Classes of Farm Animals.
1 class hour. 2 2-hour laboratory periods, 3 study hours, credit, 8.

26. **II.** Types and Breeds of Livestock. — A course covering the origin, history, development and characteristics of the different breeds of horses and sheep. Text book, Plumb's Types and Breeds of Farm Animals.
2 class hours. 1 2-hour laboratory period, credit, 3.

50. **I.** Feeds and Feeding. — For juniors. A study of the principles of animal nutrition; of the composition and qualities of feeding materials. Textbook, Henry's "Feeds and Feeding."
3 class hours. Credit, 3.
Assistant Professor Rice.

Prerequisite, Chemistry 30 or 6.

51. **II.** Feeds and Feeding. — For juniors. A study of feeding practice as related to all farm animals. Considerable work will be given in the formulating of rations.
3 class hours. Credit, 3.
Assistant Professor Rice.

Prerequisite, Animal Husbandry 50.

52. **III.** Advanced Stock Judging. — For juniors; seniors may elect. Designed to equip students in the judging of classes of different types of live stock; to strengthen them in the selection of superior sires; and equip them for stock judging at fairs. Visits are made to the best herds for the various breeds of stock in the State. Judging teams to represent the college will be selected from this class.

1 2-hour and 1 4-hour laboratory period, credit, 3.
Professor ——

Prerequisites, Animal Husbandry 25 and 26.

53. **III.** Principles of Breeding. — For juniors; seniors may elect. Designed to familiarize students with the problems that are involved in animal improvement; to acquaint them with the facts which are already established; to scrutinize prevailing theories; and to indicate the lines and methods of further work. Some of the subjects studied are: variations, their causes and heritability; DeVrie's theory of mutations; the inheritance of acquired characters; the pure line; Mendelian law; the making of new types; the determination of sex; applications to human heredity. A few periods at the end of the course are devoted especially to the application of principles in livestock improvement. Supplementary reading.

3 class hours. Credit, 3.
Assistant Professor Rice.

Prerequisites, Animal Husbandry 25, 26, Zoölogy 25.

75. **I.** Beef and Swine Production. — A study of the leading breeds of beef cattle and swine, together with the work of some of the most successful breeders. Considerable time will be given also to the production of commercial beef and pork. In this course such livestock management problems as apply to beef cattle and swine will be included.

2 lectures. 1 2-hour laboratory period, credit, 3.
Assistant Professor Glatfelter.

Prerequisites, Animal Husbandry 51, 52 and 53.

78. **II.** Horse and Sheep Production. — A study of the production of these animals planned in the same manner as that of the previous course.

2 lectures. 1 2-hour laboratory period, credit, 3.
Professor ——

Prerequisites, Animal Husbandry 51, 52 and 53.

79. **III.** Dairy Cattle and Milk Production. — A study of the leading breeds of dairy cattle, the most successful breeders and famous breeding animals, advance registry testing and feeding for production, sales methods and advertising.

2 lectures. 1 2-hour laboratory period, credit, 3.
Professor ——

Prerequisites, Animal Husbandry 51, 52 and 53.

81. **II.** Dairy and Animal Husbandry. — Seminar for seniors majoring in dairying and animal husbandry.

1 class hour. Credit, 1.
Departments of Dairying and Animal Husbandry.

82. **III.** A continuation of Course 81.

1 class hour. Credit, 1.
Departments of Dairying and Animal Husbandry.

Dairying.

Professor Judkins, Assistant Professor Yaxis, Mr. Pendleton, Mr. Smith.

The dairy manufactures building is new, well lighted and of sanitary construction. It is designed and equipped especially for teaching dairy manufactures. The equipment includes all kinds of machinery that are considered essential to the proper handling of milk and the making of cream, butter, ice cream and soft cheeses.

Course 77 is for students who desire a general idea of dairy work and manufacturing processes. Part of the courses are arranged to give instruction in general dairy work as associated with Massachusetts agriculture; part are arranged to give to a smaller group of students more complete work in dairy manufactures. Those majoring in dairy manufactures should have at least one summer's experience in a commercial plant before graduation.

Elective Courses.

50. **I.** Milk and Milk Composition. — For juniors; seniors may elect. The development of the dairy business in the United States; the composition, secretion and general characteristics of milk; contamination and fermentation; the study of analysis of milk products by use of the Babcock test for fat, tests for acidity and adulteration, and ordinary preservatives; moisture tests for butter; methods for testing herds and developing them to higher efficiency; problems.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Assistant Professor Yaxis.

51. **III.** Market Milk. — For juniors; seniors may elect. A study of market-milk conditions; extent and development of the business; supply and delivery; food value of milk and its uses as food; milk and its relation to the public health; proper methods for handling milk and cream for direct consumption; certified milk, requirements and production; pasteurizing, sterilizing, standardizing and modifying; milk laws and inspection. Some milk plants will be visited.
3 class hours. 1 4-hour laboratory period, credit, 5.
Professor Judkins and Mr. Smith.

Prerequisites, Dairying 50, Microbiology 50.

52. **II.** Judging Dairy Products. — For juniors.
2 2-hour laboratory periods, credit, 2.
Professor Judkins.

75. **II.** Butter Making. — For seniors; juniors may elect. A study of separators and cream separation; handling milk and cream for butter making; preparation of starters, and ripening cream; churning; markets and their requirements; marketing, scoring and judging butter; management; dairy machinery and care thereof; problems.
2 class hours. 2 3-hour laboratory periods, credit, 5.
Assistant Professor Yaxis.

Prerequisite, Dairying 50.

76. **III.** Ice Cream Making. — For seniors; juniors may elect. A study of the principles and practice of ice cream making. Laboratory equipment is modern and the laboratory instruction will cover commercial practices. Some ice cream plants will be visited.
2 class hours. 2 3-hour laboratory periods, credit, 5.
Mr. Pendleton.

Prerequisite, Dairying 50.

77. **III.** Dairying. — For seniors; juniors may elect. A general course primarily for those who wish to take only one course in dairying. The work covers briefly the composition and secretion of milk, the Babcock fat test, the relation of bacteria to dairy work and principles of creaming; separators; elementary butter making; proper methods of handling milk and cream; and the relation of market milk to the public health.

3 lecture hours. 2 2-hour laboratory periods, credit, 5.

Assistant Professor Yaxis.

78. **I.** Milk Products. — For seniors. The manufacture of milk products other than butter and ice cream, including cheddar cheese, soft and fancy cheese, condensed and powdered milk, casein, commercial buttermilk, etc. Laboratory exercises largely in cheese making and commercial buttermilk manufacture.

1 4-hour laboratory period, credit, 2.

Assistant Professor Yaxis.

Prerequisite, Dairying 50.

Farm Management.

Professor Foord, Assistant Professor Abell.

The purpose of the courses in this department is to present various considerations of farming as a business. This involves a knowledge of the cost of production and the profit from the different enterprises such as dairy, poultry or orchard; a study of the enterprises, and the relative amounts of each that will give the best use of labor and equipment on the farm under consideration.

The college farm of 250 acres is under the general supervision of the Department of Farm Management, and furnishes demonstration material. It includes improved land, pasture land and a farm woodlot. The improved land illustrates the value of good culture and the best known methods for the maintenance of fertility. The farm is equipped with suitable buildings and good machinery for the work carried on, of which the production of certified milk is an important branch. Several good farms in the vicinity, illustrating types of both special and general agriculture, may be inspected and studied. The offices of the department are in Stockbridge Hall.

Elective Courses.

75. **II.** Farm Accounts and Cost Accounting. — For seniors; juniors may elect. A study of farm inventories, single-enterprise accounts, complete farm accounts and farm records. Special emphasis is given to the interpretation of results and their application in the organization and management of the farm.

1 class hour. 2 2-hour laboratory periods, credit, 3.

Professor Foord.

76. **I.** Farm Management. — For seniors; juniors may elect. A study of farming as a business; regions and types of farming; the general principles of farm management and the influence of size, production, live stock and crop farming on the farmer's labor income; arrangement of fields and buildings; use of land, capital and labor; choosing and buying a farm.

2 class hours. 1 2-hour laboratory period, credit, 3.

Assistant Professor Abell.

Prerequisites, Agronomy 50, Animal Husbandry 25 and 26, and some farm experience.

77. **III.** Farm Management. — For seniors; juniors may elect. A further and more specific study of the principles and practices as outlined in Course 76, with refer-

ence to their application to different regions of the United States and especially to New England. Trips to successful farms are a required part of the course.

1 class hour. 1 4-hour laboratory period, credit, 3.

Professor FOORD.

Prerequisites, Farm Management 75 and 76.

78. **II.** SEMINAR. — For seniors majoring in general agriculture; others by arrangement.

1 class hour. Credit, 1.

Professors FOORD and ABELL.

79. **III.** SEMINAR. — For seniors majoring in general agriculture; others by arrangement.

1 class hour. Credit, 1.

Professors FOORD and ABELL.

81. **III.** FARMING IN THE UNITED STATES. — For seniors. A study of the agricultural regions of the United States and the different types and methods of farming carried on in each. The economic reasons for the establishment and maintenance of each type will be considered.

2 2-hour laboratory periods, credit, 2.

The DEPARTMENT.

Prerequisite, Farm Management 76.

Poultry Husbandry.

Professor GRAHAM, Professor SANCTUARY, Assistant Professor BANTA, Miss PULLEY.

The introductory courses (50, 51, 52) give a knowledge of the general routine of elementary poultry keeping. The advanced studies prepare men for the successful operation of poultry plants, either as owners or managers. Graduate work, preparation for further teaching, extension or investigation.

The poultry plant consists of 8 acres of land sloping gently to the west. The buildings consist of three incubator cellars equipped with a number of lamp incubators and two mammoth machines with a total capacity of 9,000 eggs; a pipe brooder house (open pipe system) and 40 colony brooder houses which give a brooding capacity for 7,000 chicks, the equipment for these houses including a large variety of coal-stove brooders and kerosene hovers; a long laying house 14 by 180 feet, which accommodates 500 layers, furnishing facilities for student work in pen management, utility and fancy judging, etc.; and a laboratory 14 by 80, for killing, picking, drawing, trussing, packing, crate fattening and cramming. The fattening equipment consists of a modern sanitary all-steel battery with 16 compartments and 10 wooden crates, accommodating, altogether, 350 birds. There are also a storage building, 28 by 64 feet, for root cellar, poultry carpentry, poultry mechanics, feed room and storage; an experimental breeding house, 18 by 60; a combination laying, testing and breeding house, 18 by 72, for experimental purposes; a model laying house, 18 by 30, for 100 hens, and a house 20 by 40, for 200 hens. The six old experiment-station houses, each 12 by 18 feet, are used as special mating and overflow pens. The total capacity for laying hens is 1,600. A manure shed 14 by 18 feet; an oil and tool house 10 by 12; an incinerator 10 by 10; and two backyard model poultry houses 8 by 10 and 8 by 8 give a total of 76 buildings, not including a pheasant run, 16 roosting sheds 10 by 10, and numerous small coops for natural incubation and brooding.

Elective Courses.

50. **I.** Judging and Culling. — Seniors. A study of the origin and evolution of our standard breeds and varieties. Judging for production quality, using trap-nested birds; culling the flock; judging exhibition quality by score card and comparison. Several farms will be visited, also several of the leading Connecticut Valley Poultry Shows. Poultry Judging Teams competing in the Intercollegiate Contest at Madison Square Garden are trained in this course.
2 class hours. 2 3-hour laboratory periods, credit, 5.
Assistant Professor Banta.

Prerequisite, Poultry 52.

51. **II.** Poultry Feeds and Feeding. — For juniors; seniors may elect. A study of the principles and practices of poultry nutrition and their relationship to other poultry problems. An important part of the work will be the practical management of a pen of birds for a period of weeks, including observations and detailed record keeping.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Assistant Professor Banta.

52. **III.** Incubation, Brooding and Growing. — For juniors; seniors may elect. A study of the fundamental principles of incubation and rearing chicks; also of modern equipment, including small and mammoth incubators and various types of brooding apparatus.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Professor Sanctuary and Miss Pulley.

Prerequisite, Poultry 51.

75. **I.** Poultry Housing and Sanitation. — For juniors; seniors may elect. A consideration of the biological and economic principles fundamental in the efficient designing, practical construction and equipping poultry farm buildings; also of external parasites and the insecticidal agents for their control.
3 class hours. Credit, 3.
Assistant Professor Banta.

Prerequisite, Poultry 50.

76. **I.** Market Poultry and Poultry Products. — Seniors. A study of the market classes of poultry, eggs and feathers, the requirements of different markets, methods of marketing, the cold storage of poultry and eggs. Preserving eggs, judging and scoring of live and dressed market poultry and market eggs are important features. Students are required to fatten pens of chickens by different methods and rations, keeping accurate data of the gains in weight and quality, also the costs of feed and labor, and resultant profit or loss. The annual market poultry show is staged under the direction of members of this class.
2 class hours. 2 2-hour laboratory periods, credit, 4.
Professor Graham and Miss Pulley.

Prerequisite, Poultry 52.

77. **II.** Poultry Breeding. — Seniors. A study of the principles of breeding and their application to poultry. Practice work in record keeping, pedigree hatching, stud and flock mating will be required as the season permits.
4 class hours. 1 2-hour laboratory period, credit, 5.
Professor Sanctuary.

78. **III.** Farm Poultry. — Seniors; juniors may elect. For those students who desire a general knowledge of poultry husbandry but who cannot devote more

than one term to the subject; it is not intended for students specializing in poultry, and such students are admitted only by special permission. Emphasis is placed on the farm flock and its economic management. Utility classification, housing, culling, feeding, hatching, rearing, production, marketing and disease control receive special consideration.

3 class hours. 2 2-hour laboratory periods, credit, 5.

Assistant Professor Banta.

79. **III.** Poultry Farm Organization. — Seniors. A study of the organization of the poultry farm for greatest efficiency. The layout of fields and buildings, crop rotations, records, accounts and advertising will receive consideration. One or more trips will be made to representative successful poultry farms.

3 class hours. 1 2-hour laboratory period, credit, 4.

Professor Graham.

Prerequisite, Poultry 77.

Rural Engineering.

Professor Gunness, Assistant Professor Strahan, Mr. Pushee, Mr. Newlon.

The courses in rural engineering are planned to give a working knowledge of those phases of engineering which apply directly to the farm. It is expected that the student will acquire a clear understanding of modern farm practice as it relates to permanent improvements of the farm and the farmstead, and in the selection and use of farm equipment.

This department has an office and the use of a lecture room in Stockbridge Hall. The work on farm structures is given in the large drawing room in the same building. This room is fitted with thirty drawing tables. Models and blue prints are available for the study of farm buildings. A set of post molds and a machine for making cement tile afford opportunity for practical work with cement.

The rural engineering shop is a one-story structure 68 by 126 feet. The carpenter shop in this building is fitted with benches fully equipped with tools for each student. The general repair shop is equipped with forges, benches, a drill press and grinders. The laboratory for farm machinery and farm motors is equipped with a complete line of field machines, gasoline engines, tractors and pumps. A complete assortment of engine accessories, consisting of carburetors, magnetos, etc., is available for thorough instruction in gas engines. A small dynamo and switchboard are used in the study of farm-lighting systems. The work on the small field machines is given in the basement of Stockbridge Hall, and the work on steam engines and steam heating is given in Flint Laboratory.

Elective Courses.

25. **I.** Carpentry. — For sophomores; juniors and seniors may elect. Practice in the use of tools by exercises in bench work, repair of farm equipment and farm building construction. Not given, **I** term, in 1923–24.

2 2-hour laboratory periods, credit, 2.

Mr. Pushee.

26. **III.** Repair of Farm Equipment. — For sophomores; juniors and seniors may elect. Exercises in forge work, pipe fitting, soldering, babbitting and fitting bearings, lining up shafting, lacing belts and splicing rope. Practice in the use of machinist's tools, such as file, cold chisel, drill press, taps and dies.

2 2-hour laboratory periods, credit, 2.

Mr. Newlon.

52. **III.** Farm Engineering. — A general course dealing with field implements, gas engines, water supply, lighting, sewage disposal, farm buildings, drainage and irrigation.
3 class hours. 2 2-hour laboratory periods, credit, 5.
The Department.

75. **I.** Farm Structures. — For seniors; juniors may elect. A study of the strength and durability of concrete, wood, stone, and clay products, and of the mechanical principles underlying their use in farm construction. The design of various farm buildings, such as the general purpose barn, dairy stable, hog house, sheep barn, milk house, etc. In the drafting room, details of construction will be worked out, a study of the mechanics of simple roof trusses will be made, and a complete design of some major farm building will be finished in all essential details. If time permits, blueprints of the finished design can be made.
2 class hours. 2 2-hour laboratory periods, credit, 4.
Assistant Professor Strahan.

78. **II** and **III.** Farm Motors. — This course deals with the gasoline engine as used for stationary work, automobiles, and tractors. Instruction is given by means of lectures and textbooks, and by operating and repairing stationary engines, automobiles, and tractors. Special attention is given to overhauling and repairing.
3 class hours. 2 2-hour laboratory periods, credit, 5.
The Department.

79. **III.** Drainage and Irrigation Engineering. — For seniors; juniors may elect. Covers the engineering phase of drainage and irrigation. The various systems are studied, and practice is given in the design of drainage and irrigation systems. Field work gives practice in surveying for drains, platting, locating drains, erecting batterboards and laying tile. Practice is given in assembling equipment for spray irrigation, and the flow of water through nozzles is studied by means of laboratory tests.
2 class hours. 1 2-hour and 1 4-hour laboratory period, credit, 5.
Assistant Professor Strahan.

81. **III.** Dairy Mechanics. — A study of dairy machinery, including steam boilers, engines, pumps, traps, refrigeration machinery, and heat-controlling devices. Practice is given in pipe fitting, packing valves, lacing belts, and similar repair jobs on the equipment used in dairy plants.
1 lecture. 1 4-hour laboratory period, credit, 3.
Professor Gunness and Mr. Newlon.

DIVISION OF HORTICULTURE.

Professor Waugh.

[Heavy-faced Roman numerals indicate the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

Floriculture.

Professor Thayer, Assistant Professor Muller.

The courses in floriculture are intended to present a general knowledge of all phases of greenhouse design, construction, heating and management, the culture of florists' crops (under glass and in the field), floral decoration and arrangement. The department aims to train students so that they may take up commercial floriculture (either

in the growing or retail business) and the management of conservatories on private estates, in parks and cemeteries.

The department is especially well equipped for the teaching work, probably being surpassed in no other agricultural college. French Hall, with its laboratories, classrooms and offices, furnishes excellent facilities for the purposes of instruction. The glass area of the department consists of approximately 20,000 square feet, divided as follows: French Hall range of 7,200 square feet, a durable, practical, commercial range composed of palm and fern, violet, carnation, rose and students' houses; the old Durfee range of 7,400 square feet, devoted to the growing of decorative, conservatory and bedding plants and chrysanthemums; one house of 3,200 square feet, suitable for propagating work and general plant culture; and approximately 2,200 square feet in cold frames and hotbeds.

In addition, the department has 2 acres of land used for the summer culture of carnations, violets, gladioli, dahlias, sweet peas, bedding plants, etc. This also includes a small garden of about 4,700 square feet devoted to the culture of annuals. A large collection of biennials and herbaceous perennials is maintained and is being enlarged from year to year; at the present time the collection consists of several hundred species and varieties, and provides an excellent opportunity for the study of garden flowers.

Elective Courses.

50. **I.** Greenhouse Management. — For juniors; seniors may elect. Designed to familiarize students with the methods followed in the management of greenhouses and of greenhouse crops and the principles underlying the same; history and development of the floricultural industry; preparation of soils; fertilizers; potting; watering; ventilation; control of insects and diseases; methods of plant propagation; forcing of plants. At some time during the term the members of the class will be required to take a one-day trip to visit large commercial establishments. Lectures, assigned readings, reports and laboratory practice.
2 class hours. 2 2-hour laboratory periods, credit, 4.
Professor Thayer.

Prerequisite, Horticulture 27.

51. **II.** Greenhouse Management. — For juniors; seniors may elect. Continuation of Course 50. Several field trips, to study floricultural establishments in the vicinity, will be made during the laboratory periods.
2 class hours. 1 4-hour laboratory period, credit, 4.
Professor Thayer.

52. **III.** Floral Arrangement. — A study of the principles underlying the arrangement and use of cut flowers and plants; funeral designs, basket and vase arrangement, table decorations, home, church and all interior decorations; a study of color as applied to such work. Lectures, assigned readings and reports. This course will be limited to ten students.
2 class hours. 2 2-hour laboratory periods, credit, 4.
Professor Thayer.

53. I. Greenhouse Construction and Heating. — For juniors; seniors may elect. The location, types, arrangement, construction, cost, equipment, heating and ventilating of greenhouse structures; the drawing of plans and study of specifications for commercial houses and conservatory ranges. Such practical work as glazing and the construction of concrete benches and cold frames is included as facilities allow. Lectures, assigned readings and problems.
3 class hours. 1 2-hour laboratory period, credit, 4.
Professor Thayer.

55. **III.** Garden Flowers and Bedding Plants. — Juniors and seniors. A study of the annuals, biennials, herbaceous perennials, bulbs, bedding plants and roses that are valuable for use in floricultural or landscape gardening work. Methods of propagation, culture and uses of the various plants are considered; identification of material. Lectures, assigned readings and reports.
2 class hours. 1 2-hour laboratory period, credit, 3.
Professors Thayer and Muller.

75. **I.** Commercial Floriculture. — Seniors. A detailed study of the important commercial cut flower crops and potted plants. Visits will be made to commercial establishments during the term. The lectures are supplemented with textbooks and assigned readings.
2 class hours. 1 2-hour laboratory period, credit, 3.
Assistant Professor Muller.

Prerequisite, Floriculture 51.

76. **II.** Commercial Floriculture. — Seniors. As stated under Course 75.
2 class hours. 1 2-hour laboratory period, credit, 3.
Assistant Professor Muller.

Prerequisite, Floriculture 75.

77. **III.** Commercial Floriculture. — Seniors. As stated under Course 75.
2 class hours. 1 2-hour laboratory period, credit, 3.
Assistant Professor Muller.

Prerequisite, Floriculture 76.

79. **II.** Conservatory Plants. — Seniors. A study of the foliage and flowering plants used in conservatory work; methods of propagation, culture, use and arrangement; identification of plants. Lectures, assigned readings and reports.
2 class hours. 1 2-hour laboratory period, credit, 3.
Professor Thayer.

Prerequisite, Floriculture 51.

80. **III.** Seminar. — For seniors majoring in floriculture. Advanced study of subjects pertaining to some phase of floriculture. All students are assigned specific problems and pursue study in these problems by reading and research; the results of this study must be presented in the form of a thesis. Seminars are conducted weekly.
2 to 6 laboratory hours, not to exceed 3 credits.
Professor Thayer.

Forestry.

Professor Grose.

The forestry courses are intended primarily for prospective owners or managers of farm woodlots, and the field work is focused on typical New England problems. These courses are broad enough, however, to furnish valuable preparation for students planning to study forestry in graduate schools.

The department has an unusually complete equipment of the various instruments used in forest mensuration, forest mapping and engineering, timber estimating, log scaling, board measuring, etc.; and a large assortment of boards illustrative of the various commercial woods found in the lumber markets. The State Forest Nursery, comprising 6 acres of land and containing, approximately, 5,000,000 trees, transplants and seedlings, is on the college farm. Forests containing every variety of tree common to New England are within walking distance of the college. The college campus affords an arboretum containing a large number of trees not native to New England. The

Mount Toby Demonstration Forest has an area of approximately 750 acres, and contains the various types of forest growth found throughout the State. It serves as a field laboratory in which students have the privilege of working out problems in silviculture, forest mensuration and management. Improvement cuttings, cuttings for utilization, and forest plantings are conducted by the department.

55. **I.** Woodlot Forestry: Estimating and Business Management. — For juniors and seniors. Topics: forest mapping; timber-cruising, determining rate of growth and possible cut; financial returns; forest taxation; our national timber supply, present and future.

1 2-hour and 1 4-hour laboratory period, credit, 3.
Professor Grose.

56. **II.** Woodlot Forestry: Logging, Milling and Marketing. — For juniors and seniors. Topics: felling trees; sawing logs; hauling logs; the portable mill; the stationary mill; seasoning, measuring and shipping lumber; lumber grades and prices; legal forms; by-products of the woodlot; adaptability of species to uses; wood-using industries of Massachusetts.

2 class hours. 1 2-hour laboratory period, credit, 3.
Professor Grose.

57. **III.** Woodlot Forestry: Timber-raising. — For juniors and seniors. Topics: forest planting; weeding; release cuttings; pruning; thinning; salvage cutting; protection from insects, fungi, fire, etc.; final cutting methods for natural reproduction of the forest.

1 2-hour and 1 4-hour laboratory period, credit, 3.
Professor Grose.

58. **III.** Woodlot Forestry: Brief Survey. — A condensation of Courses 55, 56 and 57 for those who have only one term to give to forestry.

2 class hours. 1 2-hour laboratory period, credit, 3.
Professor Grose.

Horticultural Manufactures.

Professor Chenoweth, Mr. Robertson.

The courses aim to give a practical knowledge of the problems connected with food preservation. Emphasis is placed upon the conservation of the cheaper grades of fruits and vegetables, to the end that the whole crop may be marketed at a profit and that wholesome food products may result from what would otherwise be lost. The social and economic values of this work are constantly emphasized.

The department occupies three laboratory rooms in Flint Laboratory, two in Fisher Laboratory, with offices in Wilder Hall and French Hall. The general equipment of the department, both for the use of students and for manufacturing purposes, may be grouped under the following heads: —

1. *Canning.* — A modern canning outfit, including both steam-pressure cookers and hot-water baths, hand and power can sealers, peeling and slicing machines, a string bean cutter, heat-penetration thermometers, electric incubator and a large assortment of all types of home canning equipment.

2. *Evaporation.* — Two small orchard evaporators, a tunnel drier, peeling machines, slicers and a general assortment of driers adapted to home evaporation.

3. *Fruit Juices, Butters, etc.* — A hand cider mill, a motor-driven hydraulic press, a steam-jacketed kettle, an apple-butter cooker, and cider and vinegar testing apparatus.

Elective Courses.

75. **I.** Horticultural Manufactures. — For seniors and graduate students. A practical course in food preservation dealing primarily with fruits and vegetables. The canning of fruits and vegetables as practiced in the home and in commercial canneries; evaporation of fruits and vegetables, the various types of equipment and methods of preparation of products. The manufacture of (*a*) fruit products, such as butters, jams, jellies, fruit juices, marmalades, preserves, vinegars, pastes, etc.; (*b*) vegetable products, as pickles, piccalilli, sauerkraut, soups, etc. Particular attention is given to study and use of all types of equipment suitable for use in the home or small factory, together with methods for testing a large variety of manufactured products. The emphasis is on canning, drying and study of equipment.
2 class hours. 3 2-hour laboratory periods per week, credit, 5.
Professor Chenoweth.

76. **II.** Horticultural Manufactures. — For seniors and graduate students. A continuation of Course 75. The emphasis in this course is placed on the manufacturing and testing of fruit and vegetable products.
1 class hour. 2 laboratory periods per week, credit, 3.
Professor Chenoweth.
Prerequisite, Horticultural Manufactures 75.

77. **III.** Horticultural Manufactures. — Continuation of courses 75 and 76, dealing primarily with maple products, the canning of meats and spring vegetables, and studies of special problems involved in establishing and operating home and farm factories.
2 2-hour periods per week, credit, 2.
Professor Chenoweth.

78. **III.** Horticultural Manufactures. — For seniors and graduate students. A general course in food preservation, including lectures, readings and laboratory work in the canning and evaporation of fruits and vegetables, the manufacture of fruit and vegetable products. Special emphasis will be given to the conservation of the low grade fruits and vegetables in the home and in the farm factory.
2 class hours. 2 2-hour laboratory periods, credit, 4.
Professor Chenoweth.

Horticulture.

Professor Waugh, Professor Thompson, Assistant Professor Rogers, Assistant Professor Dickinson.

The general subject of horticulture divides naturally into subjects of pomology, floriculture, forestry, landscape gardening and vegetable gardening. A number of courses relate to more than one of these subjects, and are therefore grouped here under the general designation of horticulture.

Required Course.

25. **I.** Taxonomy and Ecology of Horticultural Plants. — A study of the outstanding botanical characters of the principal families, general species and varieties of cultivated plants; together with a consideration of those principles of ecology utilized in the cultivation of plants.
1 class hour. 2 2-hour laboratory periods, 4 study hours, credit, 9.
Professor Thompson.

Elective Courses (General).

27. **III.** Nursery Practice. — For sophomores; juniors and seniors may elect. Treats of the fundamental methods of plant propagations by seeds, cuttings, budding, grafting, etc. Lectures and practicums.
2 class hours. 1 2-hour laboratory period, credit, 3.
Professor Thompson.

50. **I.** Plant Materials. — For juniors; seniors may elect. Aims to make the student familiar with the character of the trees, shrubs and herbaceous perennials used in ornamental work, and with the methods of propagating them.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Professor Thompson.

Prerequisite, Horticulture 27.

51. **III.** Plant Materials. — For juniors; seniors may elect. A continuation of Course 50, taking up the field use of trees, shrubs and herbaceous plants, their native habitats, soils and plant associations, with a view to supplying to students in landscape gardening and floriculture a knowledge of plant species. Frequent practicums and field excursions.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Professor Thompson.

Prerequisite, Horticulture 50.

Landscape Gardening.

Professor Waugh, Assistant Professor Harrison.

The purposes of the courses are: (1) To train men for the profession in all its branches. As a rule graduates should first enter the employ of established landscape architects, nurserymen or park superintendents, and after an apprenticeship of several years those who have the requisite technical and business ability may set up for themselves. (2) To train men for public-service work in national, State and municipal parks and forests. (3) To train men for country planning, this function being exercised through various public institutions and organizations. (4) To train teachers and extension workers in lines of landscape gardening and civic improvement. (5) To give a broad and liberal general education stressing the fundamental principles of art.

The department has large, well-lighted drafting rooms, with necessary equipment, such as planimeters, eidograph, pantograph, blue-printing outfit, etc.; and a complete outfit of surveying instruments, including transits, levels, plane tables, prismatic compasses, hand levels, etc. The college campus presents an unusually good collection of the plant materials used in landscape gardening.

Elective Courses.

50. **I.** Mapping and Topography. — Juniors. Reconnoissance surveys and mapping, with special reference to the methods used in landscape gardening; detailed study of selected designs of leading landscape gardeners; grade design, road design and field work. Must be followed by Course 51.
2 2-hour laboratory periods; 2 3-hour laboratory periods, credit, 5.
Assistant Professor Harrison.

Prerequisites, Mathematics 26 and 27, Drawing 25, 26 and 27, Horticulture 27.

51. **II.** Elements of Landscape Gardening. — Juniors. As stated under Course 50.

3 3-hour laboratory periods, credit, 4.
Assistant Professor Harrison.

Prerequisite, Landscape Gardening 50.

52. **III.** General Design. — Juniors. Field notes; examination of completed works and those under construction; design of architectural details, planting plans, gardens, parks and private grounds; written reports on individual problems.

2 2-hour laboratory periods; 2 3-hour laboratory periods, credit, 5.
Assistant Professor Harrison.

Prerequisites, Landscape Gardening 50 and 51, and either plant materials (Horticulture 50 and 51) or advanced mathematics.

75. **I.** Theory of Landscape Art. — For seniors and graduates. The general theory and applications of landscape study, including a brief history of the art.
3 class hours. Credit, 3.
Professor Waugh.

76. **I.** Civic Art. — Seniors. The principles and applications of modern civic art, including city planning, city improvement, village improvement and rural improvement, with special emphasis upon country planning. Must be followed by Course 77.

3 3-hour laboratory periods ,credit, 4.
Assistant Professor Rogers.

Prerequisite, Landscape Gardening 52.

77. **III.** Country Planning. — Seniors. As stated under Course 76.

3 3-hour laboratory periods, credit, 4.
Professor Waugh.

Prerequisite, Landscape Gardening 76.

78. **I.** Architecture. — Alternating with Course 79; given in 1924–25. Juniors and seniors. The history of architectural development, the different historic types, with special reference to the underlying principles of construction and design and their relations to landscape design. Illustrated lectures, conferences, practice in designing,
3 class hours. Credit, 3.
Assistant Professor Harrison.

79. **I.** Construction and Maintenance. — Alternating with Course 78; given in 1923–24. Juniors and seniors. Detailed instruction in methods of construction and planting in carrying out plans, in organization, reporting, accounting, estimating, etc.; maintenance work in parks and on estates, its organization, management, cost, etc.
3 class hours. Credit, 3.
Assistant Professor Harrison.

80. **II.** Theory of Design. — Juniors. As stated under Course 52. [Will be given in the summer term when that is established; meantime, will be given in term **I**, senior year.]

120 laboratory hours, credit, 4.
Professor Waugh.

Prerequisite, Landscape Gardening 52.

81. **II.** Estate Design.

3 3-hour laboratory periods, credit, 4.
Assistant Professor Harrison.

82. **III.** Park Design.

3 3-hour laboratory periods, credit, 4.
Assistant Professor Harrison.

Pomology.

Professor Sears, Professor Van Meter, Assistant Professor Drain, Mr. French, Mr. Raleigh.

The object of the courses is to give a training which shall be thoroughly practical and yet scientific. This will fit the men to enter the field of practical fruit-growing, or it will furnish an excellent foundation for further study.

The department has 50 acres in fruit plantations. The apple orchards comprise about 35 acres, and there are blocks of pears, peaches, plums and cherries. In small fruits there are plantings of strawberries, raspberries, blackberries, currants and gooseberries. There are three vineyards, with a total area of 5 acres, in which the leading varieties and the principal types of pruning and training are represented. In these plantations are 50 varieties of grapes, representing three native American species and many hybrids; 20 varieties of peaches; 20 varieties of pears; 25 of plums, including five species and many hybrids; and 100 varieties of apples.

The department has an excellent equipment of spraying and dusting machinery, including various styles and sizes of power sprayers, and many types of barrel pumps and smaller sprayers. There is also an excellent assortment of orchard tools, including plows, harrows, fertilizer sowers, etc.

Fisher Laboratory is one of the best planned and equipped packing and storage plants in the United States. It includes six refrigerated rooms; four storage rooms not refrigerated; one large laboratory room and one classroom, besides ample storage room for fruit packages and equipment. The equipment for the building itself includes four types of apple sizers; packing tables and box and barrel presses of various types, besides all kinds of packages and the smaller equipment necessary for thoroughly modern work in grading and packing fruit. The department is equipped with lockers and with pruning and other tools for the use of students in laboratory work, which is made a leading feature in all the courses in pomology.

Elective Courses.

50. **I.** Practical Pomology. — For juniors; seniors may elect. A study of the general principles of the growing of fruits, dealing with such questions as selection of site, soils, windbreaks, laying out plantations, choice of nursery stock, pruning, culture of orchards, orchard fertilizers, cropping orchards, etc. Lectures, supplemented with text and reference books; field and laboratory exercises.
2 class hours. 1 2-hour laboratory period, credit, 3.
Professor Sears and Mr. French.

Prerequisite, Horticulture 27.

51. **II.** Practical Pomology. — For juniors; seniors may elect. As stated under Course 50.
2 class hours. 1 2-hour laboratory period, credit, 3.
Professor Sears and Mr. French.

Prerequisite, Pomology 50.

52. **III.** Small Fruits. — For juniors; seniors may elect. A study of the growing of small fruits, including raspberries, blackberries, strawberries, currants, gooseberries and grapes, dealing with such questions as their propagation, selecting a site for the plantation, soils, fertilizers, pruning, spraying, etc.
2 class hours. 1 2-hour laboratory period, credit, 3.
Professor Sears and Mr. French.

Prerequisite, Pomology 51.

54. **II.** Systematic Pomology. — Seniors. A study of the varieties and nomenclature of the different fruits, with critical descriptions; special reference given to relationships and classification. Lectures, laboratory and field exercises.
1 class hour. 2 2-hour laboratory periods, credit, 3.
Assistant Professor Drain.

Prerequisite, Pomology 52.

75. **I.** Systematic Pomology. — Seniors. As stated under Course 54.
1 class hour. 2 2-hour laboratory periods, credit, 3.
Assistant Professor Drain.

Prerequisite, Pomology 54.

76. **II.** Orchard Management. — For seniors. Consideration will be given to the organization of a fruit farm to secure the most satisfactory distribution of income and of labor requirements. The costs of operations will be studied in connection with the keeping of orchard accounts and the estimation of supplies and equipment. The course will include a series of problems dealing with the application of principles learned in previous courses.
2 class hours. 1 2-hour laboratory period, credit, 3.
Professor Van Meter.

Prerequisite, Pomology 51.

77. **I.** Commercial Pomology. — Seniors. The picking, handling, storing and marketing of fruits, including a discussion of storage houses, fruit packages, methods of grading and packing. Especial emphasis is placed upon laboratory and field work, where the student is given actual practice in the picking and packing of all the principal fruits.
1 class hour. 2 2-hour laboratory periods, credit, 3.
Mr. Raleigh.

Prerequisite, Pomology 51.

78. **III.** Spraying. — Seniors. A study of (*a*) spraying materials, their composition, manufacture and preparation for use; the desirable and objectionable qualities of each material, formulas used, cost, tests of purity. (*b*) Spraying machinery, including all the principal types of pumps, nozzles, hose and vehicles; their structure and care. (*c*) Orchard methods in the application of the various materials used, with the important considerations for spraying each fruit and for combating each orchard pest. This course is designed especially to familiarize the student with the practical details of actual spraying work in the orchard. Spray materials are prepared, spraying apparatus is examined and tested, old pumps are overhauled and repaired, and the actual spraying is done in the college orchards and small-fruit plantations.
1 class hour. 2 2-hour laboratory periods, credit, 3.
Assistant Professor Drain.

Prerequisite, Pomology 76.

79. **II.** General Pomology. — For seniors; juniors may elect. Planned to meet the needs of students who cannot devote more than one term to the subject but who want a general knowledge of fruit growing. Consists of lectures and laboratory exercises on such topics as choosing the locations, kinds and varieties of fruits to grow, securing and setting the plants, care and cultivation, pruning, spraying, pests, harvesting and storing. Not offered in 1923–24.
2 class hours. 1 2-hour laboratory period, credit, 3.
Assistant Professor Drain.

80. **I.** Seminar. — For seniors majoring in pomology. Advanced study of problems relating to the business of fruit growing. Each student is assigned a major and

a minor problem in lines of work in which he is particularly interested. He pursues his studies both by reading and research, and the materials obtained will be worked into theses which are presented to the seminar for discussion. No lectures are given, but seminar meetings are held for one period each week.

Credit, 1.
The Department.

81. **II.** Seminar. — For seniors majoring in pomology. A continuation of Course 80. One seminar meeting each week.

Credit, 1.
The Department.

82. **III.** Seminar. — For seniors majoring in pomology. A continuation of Course 81. One seminar meeting each week.

Credit, 1.
The Department.

Vegetable Gardening.

Professor Tompson, Assistant Professor Harris, Mr. Snyder.

The courses in Vegetable Gardening are designed for students who wish to enter commercial vegetable growing, the seed business, or professional work, such as teaching or experimental work. Each of these fields offer wide possibilities and the advancement of vegetable production will depend upon the number and quality of the men trained along these lines.

The department has ten acres of land, 3,800 sq. ft. of greenhouse space, and 150 hotbed sash, all of which are used to provide laboratory facilities. Part of this equipment is used for the non-commercial laboratory work, such as the students' gardens and the type and variety garden, while the remainder is devoted to commercial laboratory work.

In addition the department maintains at Lexington, Massachusetts, the Market Garden Field Station. Here the experimental and extension work of the department is carried on.

Elective Courses.

50. **III.** General Vegetable Gardening. — Juniors; seniors may elect. A general course for those students who desire a general knowledge of agriculture, but do not care to spend the time for extreme specialization. Designed to teach the fundamentals of vegetable growing so they may be applied (1) to the growing of vegetables commercially as a cash crop with other types of agriculture, (2) to the growing of vegetables in the home garden, (3) to agricultural teaching in secondary schools, and (4) to professional agricultural work other than teaching.

3 class hours. 2 2-hour laboratory periods, credit, 5.
Assistant Professor Harris.

52. **II.** Practical Vegetable Gardening. — Juniors; seniors may elect. Courses 52 and 53 are designed for those students who wish to obtain a knowledge of vegetable growing in order that they may apply this to the successful commercial production of vegetables, or to become fitted for professional work such as teaching and research work. The course begins with a consideration of vegetables as a food, the part they play in the food supply of the city, state, or nation, and Massachusetts' part in this type of food production, followed by a study of the fundamentals of vegetable gardening. Deals with such questions as the selection of a location; soils, manures and fertilizers, green manures and cover crops; seeds and seeding; planting, tillage, irrigation; control of insects and diseases. Includes a detailed study of the cultural requirements of

the common vegetable crops, and the principles of rotation and double cropping. Text and reference books. Laboratory and field exercises.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Assistant Professor Harris.

Prerequisites, Horticulture 27, Agronomy 75.

53. **III.** Practical Vegetable Gardening. — Juniors; seniors may elect. As stated under Course 52.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Assistant Professor Harris.

Prerequisite, Vegetable Gardening 52.

75. **I.** Types and Varieties. — Seniors. Includes the systematic study of types, varieties and strains of the leading vegetable crops; exhibiting and judging of vegetables; determination of quality in vegetables; seed growing, variety improvement, rogueing, seed harvesting, curing and storing.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Assistant Professor Harris.

Prerequisite, Vegetable Gardening 53 or 50.

76. **II.** Vegetable Forcing. — Seniors. A study of types, materials, construction, location, arrangement, capacity and cost of greenhouses for growing vegetables. A brief consideration of the heating plant, — the type, installation, piping and management; also the study of greenhouse vegetable crops and their production as practiced by commercial growers.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Assistant Professor Harris.

Prerequisite, Vegetable Gardening 53 or 50.

77. **III.** Commercial Vegetable Growing. — Seniors. A consideration of vegetable growing as a business. A study of this specialized type of farming, including places where developed, types, extent, economic importance, capitalization, equipment and other fundamental problems of commercial vegetable gardening. Students assist in the planning and operation of a typical market-gardening area. Visits are made to market-gardening and truck-gardening farms.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Assistant Professor Harris.

Prerequisite, Vegetable Gardening 53 or 50.

Drawing.

Required Courses.

25. **I.** Free-hand Drawing. — For sophomores; juniors and seniors may elect. Lettering; free-hand perspective; sketching from type models, leaves, flowers and trees, houses, etc.; laying flat and graded washes in water colors; water-color rendering of leaves, flowers and trees; conventional coloring and map rendering in water colors; conventional signs and mapping in ink.
4 2-hour laboratory periods, credit, 8.

26. **II.** Mechanical Drawing. — For sophomores; juniors and seniors may elect. Inking exercises; geometric problems; projection; intersections; isometric;

shades and shadows; parallel; angular and oblique perspective; perspective drawing of buildings. Students should have preparation in plane and solid geometry.

3 2-hour laboratory periods, credit, 3.

27. **III.** MECHANICAL DRAWING. — For sophomores; juniors and seniors may elect. As stated under Course 26.

3 2-hour laboratory periods, credit, 3.

Prerequisite, Drawing 26.

DIVISION OF SCIENCE.

Professor FERNALD.

[Heavy-faced type indicates the term in which the course is given. Numbering of courses: to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

Botany.

Professor OSMUN, Assistant Professor CLARK, Assistant Professor MCLAUGHLIN, Assistant Professor TORREY, Assistant Professor DAVIS.

A knowledge of the principles of plant life is fundamental in agricultural education. The required courses in botany are planned with this and the general educational value of the subject in view. Elective courses are of two types: (1) those which have for their chief aim the direct support of technical courses in agriculture and horticulture, and (2) those providing broader, more intensive training in the science. Courses in the second group may lead, when followed by postgraduate study, to specialization in the field. They also furnish excellent training for those specializing in other sciences and in scientific agriculture. In all undergraduate courses the relation of the science of botany to agriculture is emphasized.

The department occupies Clark Hall, a brick building 55 by 95 feet, two stories high, with basement and attic. The building has two lecture rooms with seating capacity of 154 and 72, respectively; one seminar and herbarium room; large laboratories for general and special work; and smaller rooms for advanced students. A glass-enclosed laboratory for plant physiology adjoins the main building and provides unusual facilities for the study of phenomena of plant life. In addition, a greenhouse 28 by 70 feet is connected with the building. This is for experimental work in plant pathology and physiology, and for growing plants needed for instruction. The experiment station laboratories devoted to botanical research are in this building.

The laboratories and lecture rooms are of modern construction, finely lighted, and equipped with compound and dissecting microscopes, microtomes, paraffin and drying ovens, physiological and other apparatus, and a large collection of charts. The herbarium contains about 20,000 sheets of seed plants and ferns, 1,200 sheets of liverworts and mosses, and 25,000 specimens of fungi. Facilities and equipment for the study of plant physiology and pathology are excelled in few other institutions.

Required Courses.

3. **III.** INTRODUCTORY BOTANY. — Freshmen. Presents the seed plants as plastic organisms molded by their environment. Also introduces the student to methods of identifying and classifying plants.

An herbarium, illustrative of systematic, ecological and economic features, is started in the spring, but need not be presented until fall when credit is given in Course 25.

This makes it possible for the interested student to familiarize himself with the flora of the full growing season.
2 class hours. 2 2-hour laboratory periods, 4 study hours, credit, 10.
Assistant Professors Torrey and McLaughlin.

25. **I.** Introductory Botany. — Sophomores. The anatomy and physiology of the seed plants (Phanerogamia), with a brief summary of the lower forms of plant life. The herbarium started in connection with Botany 3 is presented as part of this course.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
Assistant Professor Torrey.

Prerequisite, Botany 3.

Elective Courses.

26. **II.** Morphology and Taxonomy of the Lower Plants (Cryptogamia). — Sophomores. Systematic study of typical forms of bacteria, algæ, fungi, lichens, mosses, ferns. (Courses 3, 25 and 26 constitute a general elementary course in botany, and are required of all students who major in the subject.)
1 class hour. 2 2-hour laboratory periods, credit, 3.
Professors Osmun and Torrey.

Prerequisite, Botany 25.

27. **III.** The Vascular Plants. — For sophomores; juniors and seniors may elect. Continues the work of Botany 26, but deals with the higher plants, such as ferns and fernworts, gymnosperms and angiosperms. The department possesses a unique collection of lantern slides and microscopical preparations for use in this course.
1 class hour. 2 2-hour laboratory periods, credit, 3.
Assistant Professor Torrey.

Prerequisite, Botany 26.

50. **I.** Diseases of Crops. — For juniors; seniors may elect. The lectures are general and are taken by all who elect the course, but in order to permit students to specialize on the diseases of crops most closely related to their majors or in which they are most interested, the course is divided for laboratory work into the following sections: (I) diseases of truck and field crops; (II) diseases of floricultural crops and ornamentals; (III) diseases of fruit crops; (IV) diseases of shade and forest trees. One, two or three laboratory sections may be taken.
1 class hour. 1, 2 or 3 2-hour laboratory periods, credits, 2, 3 or 4.
Assistant Professor McLaughlin.

Prerequisites, Botany 3 and 25.

51. **II.** Diseases of Crops. — For juniors; seniors may elect. As stated under Course 50.
1 class hour. 1, 2 or 3 2-hour laboratory periods, credits, 2, 3 or 4.
Assistant Professor McLaughlin.

Prerequisite, Botany 50.

52. **I.** Systematic Mycology. — For juniors; seniors may elect. Morphology and development of typical species representing the orders and families of fungi; practice in identification, collection and preservation of fungi; study of systems of classification; collateral reading. A prerequisite of the senior course in plant pathology, but open to all.
1 class hour. 2 2-hour laboratory periods, credit, 3.
Assistant Professor Davis.

Prerequisite, Botany 26.

53. **II.** Systematic Mycology. — For juniors; seniors may elect. As stated under Course 52.
1 class hour. 2 2-hour laboratory periods, credit, 3.
Assistant Professor Davis.

Prerequisite, Botany 52.

54. **III.** Systematic Mycology. — For juniors; seniors may elect. As stated under Course 52.
1 class hour. 2 2-hour laboratory periods, credit, 3.
Assistant Professor Davis.

Prerequisite, Botany 53.

55. **I.** Plant Histology. — For juniors; seniors may elect. Comparative study of the tissues of plants; training in histological methods, including the use of precision microtomes, methods of killing, fixing, sectioning, staining and mounting; collateral reading and conferences. This course offers valuable training in preparation for further work in botany.
3 2-hour laboratory periods, credit, 3.
Professors Osmun and McLaughlin.

Prerequisites, Botany 3 and 25.

56. **II.** Plant Histology. — For juniors; seniors may elect. As stated under Course 55.
3 2-hour laboratory periods, credit, 3.
Professors Osmun and McLaughlin.

Prerequisite, Botany 55.

58. **I.** Systematic Botany of the Higher Plants. — For juniors; seniors may elect. An intensive study of gymnosperms and angiosperms. Lectures deal with the interrelations of the flowering plants and with their ecology, distribution and economic importance. Laboratory work consists of a critical study of types from the most important natural plant families. Particular emphasis is laid on the flora of Massachusetts. The department herbarium and greenhouses supply material of important tropical forms for study.
2 class hours. 2 2-hour laboratory periods, credit, 4.
Assistant Professor Torrey.

59. **II.** For juniors; seniors may elect. As stated under Course 58.
2 class hours. 2 2-hour laboratory periods, credit, 4.
Assistant Professor Torrey.

75. **I.** Plant Pathology. — Seniors. Comprehensive study of diseases of plants; training in laboratory methods and technique, including culture work and artificial inoculation of hosts; miscellaneous diagnosis; study of literature and representative life histories of pathogens. Prepares for civil service, experiment station and college work.
1 class hour. 4 2-hour laboratory periods, credit, 5.
Professors Osmun and Davis.

Prerequisite, Botany 54.

76. **II.** Plant Pathology. — Seniors. As stated under Course 75.
1 class hour. 4 2-hour laboratory periods, credit, 5.
Professors Osmun and Davis.

Prerequisite, Botany 75.

77. **III.** Plant Pathology. — Seniors. As stated under Course 75.
1 class hour. 4 2-hour laboratory periods, credit, 5.
Professors Osmun and Davis.

Prerequisite, Botany 76.

78. **I.** Plant Physiology. — Seniors. Study of the factors and conditions of (*a*) Plant Nutrition, including the taking up of water and mineral substances, the assimilation of carbon and nitrogen, and the release of energy due to the processes of dissimilation; (*b*) Plant Growth, including the influence of internal and external factors on growth, the development of reproductive and vegetative organs, and touching on plant inheritance and the origin of new varieties; (*c*) Plant Movements, including those due to the taking up of water, and those movements of both motile and fixed forms in response to external stimuli. Special emphasis is laid on the development of skill in the manipulation of apparatus in the laboratory; weekly conferences are held at which students report on assignments.
2 class hours. 3 2-hour laboratory periods, credit, 5.
Assistant Professor Clark.

Prerequisites, Botany 26 and Chemistry 51.

79. **II.** Plant Physiology. — Seniors. As stated under Course 78.
2 class hours. 3 2-hour laboratory periods, credit, 5.
Assistant Professor Clark.

Prerequisite, Botany 78.

80. **III.** Plant Physiology. — Seniors. As stated under Course 78.
2 class hours. 3 2-hour laboratory periods, credit, 5.
Assistant Professor Clark.

Prerequisite, Botany 79.

82. **II.** Cytology and Embryology. — Seniors. Morphology and physiology of the cell; cell-division; embryonal development.
3 2-hour laboratory periods, credit, 3.
Assistant Professor McLaughlin.

Prerequisites, Botany 26 and 55.

83. **III.** Cytology and Embryology. — Seniors. As stated under Course 82.
3 2-hour laboratory periods, credit, 3.
Assistant Professor McLaughlin.

Prerequisite, Botany 82.

86. **I.** 87. **II.** 88. **III.** Seminar. — For seniors and graduate students. Presentation and discussion of important current botanical papers. A major requirement.
1 class hour. Credit, 1.
The Department.

General and Agricultural Chemistry.

Professor Lindsey, Professor Chamberlain, Professor Peters, Assistant Professor Serex, Assistant Professor Julian.

In teaching the courses in chemistry, emphasis is laid on both their educational and their vocational value. The courses in the freshman year deal with fundamental principles, and give the student such an understanding of the subject as will enable him to apply it in farm practice. The more advanced courses, including quantitative analysis and organic, physiological and physical chemistry, are for those who intend to become teachers and workers in the allied sciences, or who desire to follow agricultural chemistry as a vocation. Advanced training is given by means of postgraduate courses (see Graduate School).

Those completing the undergraduate courses are fitted for positions in the agricultural industries, — fertilizer, feed and insecticide manufacture, — as well as in other lines of industry, and in the State experiment stations and in commercial laboratories. Postgraduate students are prepared for positions as teachers in high schools and colleges, and for more advanced positions in industry and in the experiment stations.

The laboratory, which for many years was used for the work of the Department of Chemistry, was burned early in September, 1922. A new laboratory, to cost $300,000, is under construction and will be ready for occupancy about Jan. 1, 1924. The plans for the new building have been developed with the utmost care, and will provide a building amply suited for the adequate instruction of students in this subject.

Required Courses.

The freshman work consists of two distinct parts: Courses 1 and 2 contain more hours and are for those who have had no chemistry in the secondary schools, and Courses 4 and 5 are for those who have presented chemistry for entrance. Both groups of courses bring the student out at the same point. It is obviously to the advantage of the student to take a course in chemistry in high school and thus obviate the extra hours of Courses 1 and 2 in the freshman year.

1. **I.** General Chemistry. — Freshmen. This course is for those students who do not present chemistry for entrance and who begin the subject in college. An introduction to the fundamental chemical laws, together with a study of the common acid-forming elements and their compounds.
3 class hours. 2 2-hour laboratory periods, 5 study hours, credit, 12.
Professor Peters.

2. **II.** Agricultural Chemistry. — Freshmen. The preparation of a number of substances important in agriculture, such as superphosphate, ammonium sulfate, muriate and sulfate of potash, Paris green, arsenate of lead, Bordeaux mixture, lime-sulfur and emulsions. These materials are prepared in the laboratory and studied in detail in the classroom; some of the substances prepared may be analyzed. Particular attention will be given to a study of the composition, properties and reactions of soils. Approximate quantitative determinations of a number of constituents of soils and fertilizers will be made.
3 class hours. 2 2-hour laboratory periods, 5 study hours, credit, 12.
Professor Peters.

4. **I.** Advanced General Chemistry. — Freshmen. A review of the fundamental chemical laws, together with the common acid and base-forming elements and their compounds. Textbook, Kahlenberg's "Outlines of Chemistry." The laboratory work takes the synthetic form. Substances of agricultural importance are prepared in quantity and studied in detail by the student. These include ammonium sulfate, superphosphate, muriate and sulfate of potash, arsenate of lead, Paris green, Bordeaux mixture, lime-sulfur and emulsions.
2 class hours. 2 2-hour laboratory periods, 4 study hours, credit, 10.
Assistant Professor Serex.
Prerequisite, Entrance Chemistry.

5. **II.** Inorganic Agricultural Chemistry. — Freshmen. A study of the chemical composition, properties and reactions of soils, fertilizers, fungicides and insecticides. The laboratory work is divided into three parts: (*a*) qualitative examination of soil, plant ash and superphosphate; (*b*) approximate quantitative determination of

moisture, ash, carbonic acid, phosphoric acid, potash, etc.; (*c*) special work on retention of salts by soil, leaching of lime from the soil by carbonated water, etc.
2 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 9.
Assistant Professor SEREX.

Elective Courses.

25. **I.** QUALITATIVE ANALYSIS. — *Basic.* — Sophomores. The systematic analysis of metallic salts, presented from the ionic viewpoint. A close study of the tests used in the separation and identification of the metals; he then applies these tests to unknown mixtures. Text, Medicus' "Qualitative Analysis," with Stieglitz's "Qualitative Analysis" and Gooch & Browning's "Qualitative Analysis" for reference. This course should be taken by all intending to follow chemistry as a vocation.
1 class hour. 2 2-hour laboratory periods, 4 study hours, credit, 9.
Assistant Professor SEREX.
Prerequisite, Chemistry 2 or 5.

26. **II.** QUALITATIVE ANALYSIS. — *Acidic.* — Sophomores. A continuation of Course 25.
1 class hour. 2 2-hour laboratory periods, credit, 3.
Assistant Professor SEREX.

27. **III.** QUANTITATIVE ANALYSIS. — For sophomores; juniors and seniors may elect. Includes the gravimetric and volumetric determinations of some of the commoner metals and non-metals. Talbot's "Quantitative Chemical Analysis" is used as a text.
1 class hour. 2 4-hour laboratory periods, credit, 5.
Professor PETERS.
Prerequisite, Chemistry 25. Course 26 is prerequisite for those majoring in chemistry.

30. **III.** ORGANIC AGRICULTURAL CHEMISTRY. — Elective for sophomores, juniors and seniors who have not taken Course 6. Embraces the study of the most important groups of organic compounds of plants and animals, the composition of plants, the chemistry of plant growth, plants as food and as industrial material, the composition of animals, the chemistry of digestion, also the study of some of the products related to plants and animals, such as milk, butter, cheese, sugar and alcohol. The treatment of the subject is general, avoiding (so far as possible) complicated chemical facts and relationships, and endeavoring simply to make the student acquainted with the general chemistry of plants and animals and agricultural processes and products.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Professor CHAMBERLAIN.

51. **I.** ORGANIC CHEMISTRY. — For juniors; seniors may elect. Consists of a systematic study, both from texts and in the laboratory, of the more important compounds in the entire field of organic chemistry. Especial attention is given to those compounds which are found in agricultural products or are manufactured from them. These include alcohols, acids, esters, fats, carbohydrates and proteins. The work forms a foundation for courses in physiological chemistry and agricultural analysis, and is especially planned for those majoring in chemistry or the other sciences. Those electing Course 51 are expected to elect Course 52.
5 class hours. 2 3-hour laboratory periods, credit, 8.
Professor CHAMBERLAIN.
Prerequisites, Chemistry 2 or 5, and Chemistry 27 for those majoring in chemistry.

52. **II.** Organic Chemistry. — For juniors; seniors may elect. A continuation of Course 51, dealing principally with compounds of the benzene series.
5 class hours. 2 3-hour laboratory periods, credit, 8.
Professor Chamberlain.

62. **III.** Advanced Quantitative Analysis. — For juniors; seniors may elect. Advanced work on subjects as stated under Course 27, together with the analysis of insecticides or the analysis of soils and fertilizers.
1 class hour. 2 4-hour laboratory periods, credit, 5.
Professor Peters.
Prerequisite, Chemistry 27.

65. **III.** Physical Chemistry. — For juniors; seniors may elect. A résumé of general chemistry from the viewpoint of physical chemistry, and the application of physical chemistry to agricultural chemistry.
3 class hours. 1 4-hour laboratory period, credit, 5.
Assistant Professor Serex.
Prerequisite, Chemistry 27.

76. **I.** Milk and Butter Analysis. — For seniors; juniors may elect. A study of milk and butter analytically.
1 class hour. 2 4-hour laboratory periods, credit, 5.
Professor Peters.
Prerequisite, Chemistry 27.

77. **II.** Cattle Feed, Water and Miscellaneous Analysis. — For seniors; juniors may elect. The analysis of cattle feeds and water, with interpretations. Other materials may be analyzed.
1 class hour. 2 4-hour laboratory periods, credit, 5.
Professor Peters.
Prerequisite, Chemistry 27.

80. **I.** Physiological Chemistry. — Seniors. Supplementary to Courses 51 and 52. To those who expect to take up scientific work in microbiology, botany, agronomy, animal husbandry, etc., and who have had Courses 51 and 52, it gives acquaintance with the chemistry of the physiological processes in plants and animals, by means of which some of the important organic compounds studied in Courses 51 and 52 are built up in the living organism or are used as food by it. In the lectures the study of food and nutrition as related to both human and domestic animals is the principal subject. In the laboratory experimental studies are made of the animal body and the processes and products of digestion, secretion and excretion.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Professor Chamberlain.

86. **II.** Review of General Chemistry. — Seniors. Primarily for students majoring in chemistry; others may elect by permission from the instructor. A knowledge of physical chemistry is desirable. The review of general chemistry is largely theoretical, using Alexander Smith's "Introduction to Inorganic Chemistry" as text.
3 class hours. Credit, 3.
Professor Peters.

87. **III.** History of Chemistry. — Seniors. An historical and biographical study of chemistry and chemists. The aim of the course is: (1) to give the student a comprehensive view of the science as a whole, through a study of the development of new ideas and the establishment of new theories and laws; and (2) to arouse an enthusiastic interest in the subject and an appreciation of the true spirit of scientific

research through a sympathetic presentation of the work and lives of the great chemists who have been the creators of the chemistry of to-day. The course will consist of lectures, supplemented by systematic correlated reading, and the preparation of reports or essays.

3 class hours. Credit, 3.
Professor CHAMBERLAIN.

91. **III.** SPECIAL WORK IN AGRICULTURAL CHEMICAL ANALYSIS. — Seniors. The student is given a problem to solve either in analytical chemistry or related to the agricultural industries. This is to acquaint him with the methods used in research and with the literature, and show him how to handle problems in this field of chemistry when occasion arises.

10 laboratory hours, credit, 5.
Professor PETERS.

92. **II.** SPECIAL WORK IN PHYSIOLOGICAL AND ORGANIC AGRICULTURAL CHEMISTRY. — Seniors. In this course, as in Courses 91 to 95, the student may give his attention primarily to one line of chemical study. To those whose tastes and interests are in connection with the organic and physiological problems of agricultural chemistry, many subjects of study present themselves, among which may be mentioned: proteins, carbohydrates, fats, organic nitrogenous compounds in fertilizers and soils and their relation to plants, the commercial production of alcohol from agricultural products, dyes, digestion and dietary studies, the chemical study of dairy products, etc.

6 or 10 laboratory hours, credit, 3 or 5.
Professor CHAMBERLAIN.

Prerequisites, Chemistry 51, 52 and 80.

93. **III.** SPECIAL WORK IN PHYSIOLOGICAL AND ORGANIC AGRICULTURAL CHEMISTRY. — Seniors. As stated under Course 92.

10 laboratory hours, credit, 5.
Professor CHAMBERLAIN.

Prerequisite, Chemistry 92.

94. **II.** SPECIAL WORK IN PHYSICAL CHEMISTRY. — Seniors. The field of agricultural chemistry offers many problems that have been attacked through the methods of physical chemistry; such, for example, are the hydrolysis of salts and of minerals and the absorption of salts and fertilizers by soils. Each student selects one line of work and follows it through the course, repeating some of the original work.

6 or 10 laboratory hours, credit, 3 or 5.
Assistant Professor SEREX.

Prerequisite, Chemistry 65.

95. **III.** SPECIAL WORK IN PHYSICAL CHEMISTRY. — Seniors. As stated under Course 94.

10 laboratory hours, credit, 5.
Assistant Professor SEREX.

Prerequisite, Chemistry 94.

Entomology.

Professor FERNALD, Professor CRAMPTON, Assistant Professor ALEXANDER, Assistant Professor CASSIDY.

The introductory Courses 26 and 27, taken together, present a comprehensive view of the relation of insects to man, particularly as crop pests. The most important pests are carefully studied, together with the methods for their control. Courses 50 and 51 are arranged for special study of the pests of any one line of agricultural or horticultural

occupation, selected by the student according to his plan of future work, with the intent of making him thoroughly familiar with the pests he will meet in his selected work after graduation, and the means of controlling them. The remaining courses are for the training of men as State or experiment station entomologists; for those going into the care of trees, etc., on estates, or for cities and towns; and as entomological experts, for which the demand has been very large.

Fernald Hall provides excellent lecture rooms and laboratories for this department. The laboratories are provided with individual desks, equipped with microscopes and all needed apparatus of all kinds. Dissecting microscopes, binoculars, microtomes, photographic apparatus, glassware and reagents are available for use and electric light and gas are connected with each desk. Two laboratories, one for juniors and seniors, the other for graduate students, are thus equipped. A department library containing all the more important works on insects, supplemented by others on the subject in the main library, and by the private libraries of the professors, make available more than 25,000 books and pamphlets on this subject. In addition, all the current magazines are received and their files are accessible to every one. A card catalogue giving references to the published articles on different insects contains about 65,000 cards, and is probably the largest index of its kind in the world. Spray pumps, nozzles and spraying appliances of all kinds are in use in various parts of the courses, and a large collection of insecticides is accessible for study. Photographic rooms are specially prepared for the photography of insects, and the greenhouses, gardens, orchards and the grounds of the college provide wide opportunities for the study, under natural conditions, of insect pests.

Elective Courses.

26. **II.** General and Economic Entomology. — For sophomores; juniors and seniors may elect. For students who desire some knowledge of insects, but who cannot give more than two terms to the subject. Also serves as an introduction to the later courses for those who intend to follow entomology farther. Touches briefly upon the structure of insects so far as this is needed for such a course; deals with metamorphosis, classification to the larger groups, and discusses the most important methods and materials used for control. The greater part of the time is devoted to special study of the most important insect pests, particularly of New England, showing their modes of life, the injuries they cause, and the best methods of control. In this way the most serious pests of fruit trees, ornamental trees and shrubs, market-garden and greenhouse pests, those attacking field crops and those affecting animals and man, are treated. Lectures and recitations. Students taking this course may choose between Courses 27, **III** and 28, **III**.

3 class hours. Credit, 3.

Professor Fernald.

27. **III.** General and Economic Entomology. — A continuation of Course 26. Lectures and recitations, completing the subject.

2 class hours. Credit, 2.

Professor Fernald.

Prerequisite, Entomology 26.

28. **III.** Economic Entomology. — A continuation of Course 26, with field work from about May 1; lectures and recitations till about May 1; two-hour field periods thereafter. In the field the work of insects will be studied and collections of insects made. Methods of collecting, mounting and preparing insects for collections will be taught. Class limited to 30 members.

2 class hours till about May 1; thereafter 2 2-hour field periods. Credit, 2.

Professors Fernald, Crampton, Alexander.

Prerequisite, Entomology 26.

50. **I.** Pests of Special Crops. — For juniors; seniors may elect. For students not majoring in entomology. The laboratory work is largely individual in this term. Accordingly, students majoring in subjects other than entomology, but who desire a more complete knowledge of the insects connected with their own major line of work, can obtain it here. A student majoring in floriculture, for example, will devote his laboratory time to a careful study of the insects injuring floricultural crops, learning how to recognize them and their work in their different stages, and the best methods for their control. Courses of this kind are available on the insects attacking field crops, market-garden crops, tree fruits, small fruits, shade trees and shrubs, flowers, forest trees, the domesticated animals, household pests and man. This work may be continued in the winter term also. (See Course 51, **II.**)

3 2-hour laboratory periods, credit, 3.
Professor Fernald.

Prerequisites, Entomology 26 and 27 or 28.

51. **II.** Pests of Special Crops. — As stated in Course 50, **I.** For students not majoring in entomology. Those who were not able to take Entomology 50 in the fall may take it here. Those who took Entomology 50 in the fall have an opportunity to continue the work during this term also.

3 2-hour laboratory periods, credit, 3.
Professor Fernald.

52. **II.** Insecticides and their Application. Classification of Insects. — For juniors majoring in entomology. Lectures on the composition, preparation and methods of application of insecticides. Laboratory work on classification of insects, particularly those for which insecticides are used.

1 class hour. 2 2-hour laboratory periods, credit, 3.
Professors Fernald and Alexander.

Prerequisite, Entomology 53.

53. **I.** Insect Morphology. — For juniors majoring in entomology. The lectures treat of the external and internal anatomy of insects, particularly of those characters used in identification, a knowledge of which is needed in the accompanying laboratory work. In the laboratory the external anatomy of the most important groups is studied, followed by the identification of insects of these groups, to show how the characters are made use of in learning the names of insects, and to teach the use of analytical keys.

2 class hours. 3 2-hour laboratory periods, credit, 5.
Professor Crampton.

Prerequisites, Entomology 26 and 27 or 28.

54. **I.** Insect Classification. — For juniors majoring in entomology. Systematic identification of insects of various groups. Study of various entomological publications and methods of finding the literature on any insect.

3 2-hour laboratory periods, credit, 3.
Assistant Professor Alexander.

Prerequisite, Entomology 53.

56. **II.** Pests of Special Crops. — For juniors majoring in entomology. Individual laboratory work on the most important insect pests of this country, and the preparation and presentation of bulletin material on them.

3 2-hour laboratory periods, credit, 3.
Professor Fernald.

55. **III.** Economic Entomology. — For juniors majoring in entomology. Continuation of lectures on insecticides; laboratory work on the identification of insect pests, the relations of insects to disease.
1 class hour. 2 2-hour laboratory periods, credit, 3.
Professors Fernald, Crampton and Alexander.
Prerequisites, Entomology 52 and 53.

75. **III.** Forest and Shade-tree Insects. — For juniors; seniors may elect. The lecture work deals with the principles and methods of controlling insects which attack forests and forest products, shade trees, etc. The laboratory periods are devoted to a study of the more important species, their identification, biology and specific control measures. Field work supplements laboratory study if time permits.
1 class hour. 3 2-hour laboratory or field periods, credit, 4.
Assistant Professor Alexander.
Prerequisites, Entomology 26 and 27 or 28; 53 and 54 desirable.

76. **I.** Advanced Entomology. — For seniors. Studies on insect bionomics; scale insects, their structure, habits, methods of mounting, identification, etc.; studies of the animals not insects with which entomologists are expected to deal.
2 class hours. 3 2-hour laboratory periods, credit, 5.
Professors Crampton and Alexander.
Prerequisite, Entomology 55.

77. **II.** Advanced Entomology. — Studies of the life history, habits and methods of control of the important insect pests of the United States; recognition tests of these pests and an examination of the literature on them; methods of bulletin preparation.
3 2-hour laboratory periods, credit, 3.
Assistant Professor Alexander.
Prerequisite, Entomology 76.

78. **III.** Advanced Entomology. — Classification of insects and of their early stages; principles of classification, the use of literature on entomology and the preparation of bibliographies and indices; the enemies of insects.
1 class hour. 3 2-hour laboratory or field periods, credit, 4.
Professors Fernald, Crampton and Alexander.
Prerequisite, Entomology 77.

90. **II.** Evolution. — For juniors; seniors may elect. In order to demonstrate the universal scope and operation of the laws of evolution, the course includes a brief sketch of the probable origin and evolution of matter as viewed in the light of modern physical and chemical research; the evolution of the solar system, leading to the formation of the earth; the changes in the earth, preparatory to the production of life; the physical and chemical basis of life; the probable steps in the formation of living matter, and the theories concerning it; the evolution of living things; the developmental history of man, and of the races of mankind, the evolution of human intelligence, languages, culture, institutions, etc., and man's probable future in the light of his past development. Especial consideration is given to the factors of evolution, the basic principles of heredity, sex-determination, variation and similar topics, with particular reference to their application to human welfare; and the recent contributions in the field of entomology to the advancement of our knowledge of these fundamental principles are briefly reviewed.
3 class hours. Credit, 3.
Professor Crampton.

Courses in Beekeeping.

65. **III.** Introductory Beekeeping. — For juniors. A detailed study of the normal behavior of the honey bee and the colony as a whole, followed by a study of such practical work of the apiary as is carried on in spring and summer. In so far as possible the laboratory work parallels the lecture work, and both are made to follow the seasonal processes of the colony. Spring management, swarm control and the production and care of the honey crop are covered thoroughly. The course is designed to meet the needs of the horticulturist as well as those of the honey producer, and should be followed by Course 85, **I.**
1 class hour. 2 2-hour laboratory periods, credit, 3.
Assistant Professor Cassidy.

85. **I.** Introductory Beekeeping. — For seniors. A continuation of Course 65 and a completion of the beekeeping year. Fall management, preparation for winter and wintering are studied in detail in lectures and laboratory work. It is highly advisable for those taking Course 65 to take Course 85, and thus complete the annual cycle of beekeeping activity.
2 class hours. 1 2-hour laboratory period, credit, 3.
Assistant Professor Cassidy.

86. **II.** Advanced Beekeeping. — For seniors. A study of the special problems with which the beekeeper deals. The diagnosis and control of the various bee diseases, production of wax, sources of nectar, honey, bee anatomy and physiology, and marketing of the crop are some of the principal topics discussed. The course is designed for those who intend going into honey production either as a principal occupation or as a side line.
2 class hours. 1 2-hour laboratory period, credit, 3.
Assistant Professor Cassidy.

Mathematics and Civil Engineering.

Professor Ostrander, Professor Machmer, Assistant Professor Moore, Mr. Porter.

The work of the freshman year is required. It is intended to furnish the necessary drill and groundwork needed for many of the scientific and practical courses of other departments. Thoroughness and accuracy are insisted upon. The advanced work in mathematics is taught from a practical standpoint, and many of its applications to other subjects are given. The courses in surveying and civil engineering are given to furnish the groundwork for a professional career. Special emphasis is given to the subjects bearing on highway construction and maintenance.

For drawing, a room on the north side is used for the draughting. It has draughting tables, T squares, scales, etc., for twenty students. Vernier protractors, parallel rules and steel T squares are available for precise work. A small room is devoted to blue printing.

In surveying, the department has a considerable number of chains and tapes, two railroad compasses, a builder's level, two dumpy levels, two Y levels and two old levels used for teaching the adjustments. Six transits are available for student use. Two are provided with solar attachments. An omnimeter with vernier reading to ten seconds is available for geodetic work. A hand level, mining aneroid barometer, and prismatic compass are provided for reconnoissance work. A set of Gilmore's needles and a Fairbanks' machine are used for cement testing.

Required Courses.

1. **I.** Higher Algebra. — Freshmen. A brief review of radicals, quadratic equations, ratio and proportion, and progressions; graphs, binomial theorem, undetermined coefficients, summation of series, variation, continued fractions, determinants, permutations and combinations, logarithms, theory of equations. Reitz and Crathorne's "College Algebra."
4 class hours, 6 study hours. Credit, 10.
Professors Machmer, Moore and Mr. Porter.

2. **II.** Higher Algebra. — As stated under Course 1. Required of all who present solid geometry for entrance.
3 class hours, 4 study hours. Credit, 7.
Professors Machmer, Moore and Mr. Porter.

3. **II.** Solid Geometry. — Freshmen. Theorems and exercises on the properties of straight lines and planes, dihedral and polyhedral angles, prisms, pyramids and regular solids; cylinders, cones and spheres; spherical triangles and the measurement of surfaces and solids. Wentworth and Smith's "Solid Geometry." Required unless accepted for admission.
3 class hours, 4 study hours. Credit, 7.
Professors Machmer, Moore and Mr. Porter.

4. **II.** Mensuration and Computation. — Freshmen. A review of methods of computation, with special emphasis on short and abbreviated processes, together with methods of checking computations and of forming close approximations; use of slide rule. Also the graph, mensuration of plane and solid figures, weights and measures and elementary mechanism. Numerous practical problems are selected from such subjects as the following: the mathematics of woodworking; rough lumber; general construction; forestry methods in heights of trees; pulleys, belts and speeds; power and its transmission; dairying; agronomy; computation of areas from simple measurements.
2 class hours, 3 study hours. Credit, 5.
Professor Machmer and Mr. Porter.

5. **III.** Plane Trigonometry. — Freshmen. The trigonometric functions as lines and ratios; proofs of the principal formulas, transformations; inverse functions, use of logarithms; the applications to the solution of right and oblique triangles; practical applications. Bowser's "Elements of Plane and Spherical Trigonometry."
3 class hours, 6 study hours. Credit, 9.
Professors Machmer, Moore and Mr. Porter.

Elective Courses.

26. **II.** Plane Surveying. — For sophomores; juniors and seniors may elect. The elements of the subject, including the adjustment and use of the usual instruments. Textbook and lectures.
2 class hours. Credit, 2.
Professors Ostrander and Moore.

27. **III.** Plane Surveying. — For sophomores; juniors and seniors may elect. As stated under Course 26. Includes field work.
3 2-hour laboratory periods, credit, 3.
Professors Ostrander and Moore.

Prerequisite, Mathematics 26.

50. **I.** Analytic Geometry. — For juniors; seniors may elect. A discussion of the geometry of the line, the circle, conic sections, and the higher plane curves. Fine and Thompson's "Co-ordinate Geometry."
3 class hours. Credit, 3.
Professor Machmer.

Prerequisites, Mathematics 1, 2, 3 and 5.

51. **II.** Differential and Integral Calculus. — For juniors; seniors may elect. A first course in the subject, with some of the more important applications. Granville's "Differential and Integral Calculus."
5 class hours. Credit, 5.
Assistant Professor Moore.

Prerequisites, Mathematics 1, 2, 3 and 5.

52. **III.** Integral Calculus. — For juniors; seniors may elect. A continuation of Course 51.
5 class hours. Credit, 5.
Assistant Professor Moore.

Prerequisite, Mathematics 51.

53. **II.** Elementary Structures. — For juniors; seniors may elect. An elementary course in roofs and bridges. Textbook and lectures.
3 class hours. 1 2-hour laboratory period, credit, 4.
Professor Ostrander.

75. **I.** Hydraulics and Sanitary Engineering. — For seniors; juniors may elect. Hydrostatics, theoretical hydraulics, orifices, weirs, pipes, conduits, water supply, hydraulic motors, sewers and sewage treatment. Textbook and lectures.
5 class hours. Credit, 5.
Professor Ostrander.

76. **I.** Materials of Construction, Foundations and Masonry Construction. — For seniors; juniors may elect. Textbook and lectures.
4 class hours. 1 2-hour laboratory period, credit, 5.
Professor Ostrander.

77. **II.** Roads and Railroads. — For seniors; juniors may elect. Topographic and higher surveying, highway construction, earthwork, pavements and railroad construction. Textbook and lectures.
3 class hours. Credit, 3.
Professor Ostrander.

78. **III.** Roads and Railroads. — For seniors; juniors may elect. As stated under Course 77.
3 2-hour laboratory periods, credit, 3.
Professor Ostrander.

Prerequisite, Mathematics 77.

Microbiology.

Professor Marshall, Assistant Professor Itano, Mr. Avery, Miss Garvey.

Three objectives are sought in the arrangement of the courses following: (1) Introductory courses (50 and 51) needed in the general training of every college student. (2) An introductory course followed by a specific course (as 80, 81, 82, 83), necessary to every student engaged in the Division of Agriculture, with which the specific course deals. (3) Introductory courses (50 and 51) followed by Courses 52, 75, 76 and 81, preparatory for students who are aiming to specialize in agricultural microbiology.

(Courses 75, 76 and 81 are adapted to those having Courses 50 and 51 only, and are also adapted to those majoring in microbiology.)

The microbiological work is carried on in a building especially designed for it. There are 4 class laboratory rooms, 8 private laboratory rooms, 1 lecture room, 5 incubator rooms, 3 sterilizing rooms, 3 hood rooms, 3 washing rooms, 3 inoculating rooms, 3 weighing rooms, an animal room, a photographic and a dark room, a sub-basement refrigerator room, a library and 4 office rooms.

The class laboratory rooms are so arranged that individual desks are available for student use. Hot and cold water and gas connections are convenient for each desk; high-pressure steam and electric connections are also available. The building is well lighted and of sanitary construction; all the walls are of brick, and the building is fireproof.

The library is equipped with such books and current periodicals as are useful in the conduct of bacteriological work and investigations. Twenty-four scientific magazines are available regularly.

There are incubators, both electric and gas, hot-air sterilizers, ordinary steam sterilizers, autoclaves, an inspissator, blood-testing apparatus, vacuum apparatus, air-pressure apparatus, shaker, grinder, centrifugal machines, a water still of 5 gallons per hour capacity, Hoskins' combustion furnace, a balopticon, complete microphotographic equipment, microscopes, microtome, and such other apparatus, glassware and chemicals as are needed for extensive and intensive work.

25. **I.** Personal Hygiene. — For sophomores. Such subjects as the hygiene of the mouth and teeth, the gastro-intestinal tract, food, the skin, respiration apparatus, ear, eye and nervous system are reviewed. The value of bathing, clothing, physical exercise, etc., are considered. Attention is given to emergencies, accidents of "first aid," and such other matters as usually fall within this category. Not offered in 1923–24.
2 class hours. Credit, 2.
Professor Marshall and Miss Garvey.

26. **II.** For sophomore men. An extension of Course 25.
2 class hours. Credit, 2.
Professor Marshall and Miss Garvey.

In place of Military 26; winter term, sophomores.

27. **III.** Sanitary Science. — For sophomores. The usual topics of sanitary science, as ventilation, heating, plumbing, water supply, sewage disposal, food control and communicable diseases, are treated from the standpoint of individual and public health control.
2 class hours. Credit, 2.
Professor Marshall and Miss Garvey.

In place of Military 27; spring term, sophomores.

Elective Courses.

50. **I, II** and **III.** Introductory and General Microbiology. — For juniors; seniors may elect. Aims to provide elementary basis for microbial studies and interpretation, to enable students to pursue special pertinent courses which will serve as supports in practical electives or majors, and to furnish students with such material as will be valuable in understanding public health problems.
2 class hours. 3 2-hour laboratory periods, credit, 5.
Professor Marshall and Mr. Avery.

51. **II** and **III.** Morphological, Cultural and Physiological Microbiology. — For juniors; seniors may elect. Types of micro-organisms, technic of handling,

methods of culture and functions of micro-organisms are considered. This course is fundamental to all advanced and extended microbiological studies.

10 laboratory hours, credit, 5.
Mr. Avery.

Prerequisite, Microbiology 50.

52. **III.** Advanced Morphological, Cultural and Physiological Microbiology. — For juniors; seniors may elect. Prepares for a more intimate knowledge of microbiological agricultural problems. To accomplish this object it is necessary to provide more advanced technique and methods of culture, together with a more extensive knowledge of micro-organisms and their functions.

10 laboratory hours, credit, 5.
Assistant Professor Itano.

Prerequisites, Microbiology 50 and 51.

75. **II.** Agricultural Microbiology. — For seniors; juniors may elect. This general comprehensive course is designed to cover in an elementary manner those subjects only which confront the student of general agriculture, — the microbiological features of air, water, sewage, soil, dairy, fermentations, food, vaccines, antisera, microbial plant infections, methods and channels of infections, immunity and susceptibility, microbial infections of man and animals, methods of control or sanitary and hygienic practices.

10 laboratory hours, credit, 5.
Mr. Avery.

Prerequisites, Microbiology 50 and 51.

76. **III.** Agricultural Microbiology. — For seniors; juniors may elect. As stated under Course 75.

10 laboratory hours, credit, 5.
Mr. Avery.

Prerequisites, Microbiology 50 and 75.

80. **II.** Soil Microbiology. — For seniors; juniors may elect. Such subjects as the number and development of micro-organisms in different soils; the factors which influence their growth, food, reaction, temperature, moisture and aeration; the changes wrought upon inorganic and organic matter in the production of soil fertility, ammonification, nitrification and denitrification; fixation of nitrogen symbiotically and non-symbiotically; methods of soil inoculation receive attention.

10 laboratory hours, credit, 5.
Assistant Professor Itano.

Prerequisites, Microbiology 50 and 51.

81. **I.** Hygienic Microbiology. — For seniors; juniors may elect. An attempt will be made to select certain material which is basic to public hygiene and sanitation, as applied to man and animals. The microbiology of water supplies, food supplies, vaccines, antisera or antitoxins; the channels by which micro-organisms enter the body, the influence of body fluids and tissues upon them, body reactions with micro-organisms (susceptibility and immunity); the micro-organisms of some of the most important infectious diseases, methods of control, including disinfectants and disinfection, antiseptics, antisepsis and asepsis, will be treated.

10 laboratory hours, credit, 5.
Assistant Professor Itano.

Prerequisites, Microbiology 50 and 51.

82. **I.** Dairy Microbiology. — For seniors; juniors may elect. Special emphasis is placed upon milk supplies. The microbial content of milk, its source, its significance, its control; microbial taints and changes in milk; groups or types of organisms found in milk; milk as a carrier of disease-producing organisms; the value of straining, aeration, clarification, centrifugal separation, temperature, pasteurization; the abnormal fermentations of milk; bacteriological milk standards and their interpretation; ripening of milk and cream; the bacterial content of butter; a passing survey of the microbiology of cheeses; a study of special dairy products, as ice cream, condensed milk, artificial milk drinks (the products of microbial actions), represents a list of topics considered.

10 laboratory hours, credit, 5.
Professor Marshall and Miss Garvey.

Prerequisites, Microbiology 50 and 51.

83. **III.** Food Microbiology. — For seniors; juniors may elect. A study of the principles of food preservation, and food preservation by means of drying, canning, refrigerating and addition of chemicals, will be pursued. Food fermentations, as illustrated by bread, pickles, sauerkraut, ensilage, vinegar, wine, etc., will be examined. Decomposition of foods, as may be seen in meat, oysters, fish, milk, etc., as well as diseased and poisonous foods, will receive consideration. Contamination of food supplies by means of water, sewage, handling, exposure, diseased persons, etc., is of especial significance, and will be demonstrated by laboratory exercises. Laboratory inspection of foods is now a subject of great import and is given attention.

10 laboratory hours, credit, 5.
Professor Marshall and Miss Garvey.

Prerequisites, Microbiology 50 and 51.

Physics.

Professor Hasbrouck, Professor Harrington, Mr. Alderman.

The fundamental and basic importance of the laws and phenomena of physics makes necessary no explanation of the introduction of this subject into the curriculum of an agricultural college. The logical development of the subject emphasizes the importance of physics as a science in itself. Special emphasis is laid, however, on the correlation of the principles studied with the sciences of agriculture, botany, chemistry and zoölogy, thus furnishing an extra tool by use of which the student's work in all the subjects may be more effective.

In Courses 25, 26 and 27 the subject-matter is presented with the idea of its special application primarily in the work in agriculture and general science. The full year's work is advised for all students continuing work specifically in the Division of Science. Courses 25 and 26 are required of all students. The subject-matter is especially selected and arranged for its practical application rather than its theoretical development. Courses 50, 51 and 52 are advised for students in chemistry, general biology, microbiology and general science. The subject-matter is selected, and the courses developed, with the idea of making the student proficient in laboratory manipulation. Sufficient theory is given in connection with the work to enable the student to apply the knowledge and practice thus gained in the departments indicated above.

The department has at its command a building on the east campus, containing a general lecture room and laboratory for sophomore work, a laboratory for junior work, and in the basement one small laboratory for quantitative work in light measurement. There is also in the basement a fairly well-equipped shop for the repair and construction of apparatus used in the department work. The usual apparatus for the demonstration in the lecture room is in the possession of the department.

Required Courses.

25. **I.** General Physics. — Sophomores. Mechanics of solids and fluids. This course includes statics, with equilibrium of rigid bodies, work, energy and friction; kinetics, considering rectilinear motion and motion in a curved path; harmonic motion; rotation of rigid bodies, including kinematics of rotation; liquids and gases, with properties of fluids at rest and in motion; properties of matter and its internal forces, including elasticity, capillarity, surface tension.

3 class hours. 1 2-hour laboratory period, 4 study hours, credit, 9.

Professors Hasbrouck and Harrington and Mr. Alderman.

26. **II.** Electricity and Magnetism. — Sophomores. Includes such subject-matter as magnetism, electrostatics, electric currents with their production, chemical, heating and mechanical effects; battery cells, measurement of voltage, current flow and resistance, motors and generators.

3 class hours. 1 2-hour laboratory period, credit, 4.

Professor Harrington and Mr. Alderman.

Elective Courses.

27. **III.** Heat and Light. — For sophomores; juniors and seniors may elect. Thermometry, expansion, colorimetry and specific heat, transmission of heat, changes of state, radiation and absorption. Wave theory of light, optical instruments, analysis of light, color, interference, diffraction, polarization.

3 class hours. 1 2-hour laboratory period, credit, 4.

Professor Hasbrouck and Mr. Alderman.

50. **I.** 51. **II.** 52. **III.** Experimental Physics. Mechanics, Sound, Heat, Light, Electricity and Magnetism. — For juniors; seniors may elect. This course consists of a series of physical measurements in the laboratory, accompanied by lectures. The lectures deal chiefly with the methods and principles involved in the laboratory work. High-grade instruments of precision are employed in the laboratory work, and the student is expected to acquire some ability to make accurate observations. The primary object of the course is to develop in the student scientific habits of thinking by direct personal observation of physical phenomena.

1 class hour. 2 2-hour laboratory periods, credit, 3.

Professor Harrington.

Prerequisite, Physics 27 or other science, subject to the approval of the Department.

55. **III.** Analytical Mechanics. — For juniors; seniors may elect. An introduction to the application of the calculus to the mechanics of solids; statics and kinetics of rigid bodies; elasticity; vector analysis. For students who have taken or are taking Mathematics 52.

3 class hours. Credit, 3.

Mr. Alderman.

75. **I.** 76. **II.** 77. **III.** Theory of Light. — For seniors. Propagation of light, formation of optical images, photography, optical instruments, interference, diffraction, spectroscopy, optical phenomena of the atmosphere, polarization and double refraction, magneto-optics, photo-electricity, radiation, electromagnetic waves, X-rays and crystal structure, electron theory, principle of relativity.

3 class hours. Credit, 3.

Professor Harrington.

Prerequisite, Mathematics 51.

Veterinary Science and Animal Pathology.

Professor Gage, Assistant Professor Lentz, Assistant Professor Pyle.

The courses in veterinary science have been arranged to meet the needs (1) of students who propose following practical agriculture; (2) of prospective students of human and veterinary medicine; and (3) of teachers and laboratory workers in the biological sciences.

The department occupies a modern laboratory and hospital stable, built in accordance with the latest principles of sanitation. Every precaution has been taken in the arrangement of details to prevent the spread of disease, and to provide for effective heating, lighting, ventilation and disinfection.

The main building contains a large working laboratory for student use, and several small private laboratories for special work. There is a lecture hall, a museum, a demonstration room, a photographing room and a workshop. The hospital stable contains a pharmacy, an operating hall, a post-mortem and dissecting room, a poultry section, a section for cats and dogs, and 6 sections, separated from each other, for horses, cattle, sheep and swine. The laboratory equipment consists of a dissectible Auzoux model of the horse and Auzoux models of the foot and the leg, showing the anatomy and the diseases of every part. The laboratories also have modern, high-power microscopes, microtomes, incubators and sterilizers, for work in every department of veterinary science, including pathology, serology and parasitology. There are skeletons of the horse, the cow, the sheep, the dog and the pig, and a growing collection of anatomical and pathological specimens. The lecture room is provided with numerous maps, charts and diagrams.

Elective Courses.

50. **II.** Veterinary Hygiene and Stable Sanitation. — For juniors; seniors may elect. Familiarizes students with the relation of water, food, air, light, ventilation, care of stables, disposal of excrement, individual hygienė, etc., to the prevention of disease in farm animals.

5 class hours. Credit, 5.

Assistant Professor Lentz.

53. **I.** Gross Veterinary Anatomy. — For juniors; seniors and graduate students may elect. The detailed study of the skeleton is followed by dissection of the muscular system and the study of joints. Not offered in 1923–24.

2 3-hour laboratory periods, credit, 3.

The Department.

54. **II.** Gross Veterinary Anatomy. — For juniors; seniors and graduate students may elect. The continuation of Veterinary 53, consisting of dissection and study of the circulatory, nervous, digestive, respiratory, and genito-urinary systems. Not offered in 1923–24.

2 3-hour laboratory periods, credit, 3.

The Department.

Prerequisite, Veterinary 53.

75. **I.** Comparative (Veterinary) Anatomy. — For seniors; juniors may elect. The anatomy of the horse is studied in detail, and that of other farm animals, particularly the ox. This course is essential for those students wishing to elect Course 77. It is a lecture and demonstrational course and open to all students interested. It is not a course in dissection anatomy.

5 class hours. Credit, 5.

Assistant Professor Lentz.

76. **II.** General Veterinary Pathology. — For seniors; juniors may elect. Fundamental, general, pathological conditions, as for example, inflammation, fever, hypertrophy, atrophy, etc., a knowledge of which is essential in prevention, diagnosis, and treatment of disease, are studied. The course in pathology is followed by a brief consideration of materia medica, therapeutic measures, and poisonous plants.

5 class hours. Credit, 5.

Assistant Professor Lentz.

77. **III.** Applied General Pathology. — For seniors; juniors may elect. This course is a continuation of Course 76. Particular attention is given to the etiology, the pathogenesis and the prophylaxis of the communicable and non-communicable diseases of the different species of domesticated animals. Lectures and demonstrations.

5 class hours. Credit, 5.

Assistant Professor Lentz.

Prerequisites, Veterinary 75 or Veterinary 78, 79 and 80.

78. **I.** Essentials of General Pathology. — For seniors; juniors may elect. Introduces students to some of the essential anatomical, histological and general physiological phenomena essential to the understanding of some of the simple general pathological conditions found in domestic animals. Some of the common methods of diagnosis are considered in the laboratory. The various chemical and biological reactions and tests are presented from the standpoint of pure science, showing applications of chemistry and biology. The course serves to educate liberally and stimulate in the student of agriculture the appreciation of some of the methods used in animal pathology for detecting and controlling some of the more common animal diseases. Lectures, demonstration and laboratory work.

2 3-hour laboratory periods, credit, 3.

Professor Gage.

79. **II.** Essentials of General Animal Pathology. — For seniors; juniors may elect. A continuation of Course 78, devoted to a study of some of the common pathological conditions by means of prepared sections, the aim being to demonstrate to the student abnormal animal histological structures commonly observed when material from various cases of animal diseases is prepared for microscopical study. Some of the biological products used in protecting animals against disease are considered.

2 3-hour laboratory periods, credit, 3.

Professor Gage.

Prerequisite, Veterinary 78.

80. **III.** Essentials of General Animal Pathology. — For seniors; juniors may elect. As stated in Courses 78 and 79.

2 3-hour laboratory periods, credit, 3.

Professor Gage.

Prerequisite, Veterinary 79.

85. **I.** Avian Pathology. — For seniors; juniors may elect. A course in poultry diseases. The object is to present information concerning the common diseases of poultry, their etiology, diagnosis and prevention. Consists of a systematic study of the diseases of the alimentary tract, liver and abdominal region, followed by a study of the diseases of the respiratory system, circulation and kidneys. The important disease-producing external and internal parasites are considered; also diseases of the skin and reproductive organs. Lectures and demonstrations.

2 3-hour laboratory periods, credit, 3.

Assistant Professor Pyle.

86. **II.** Avian Pathology. — For seniors; juniors may elect. As stated under Course 85, also devoted to the study of some of the special diseases of poultry. Recent methods used in the control of these diseases are considered and opportunity offered the student for demonstrating various disease processes by means of prepared slides. Lectures, demonstrations and laboratory work.

2 3-hour laboratory periods, credit, 3.
Assistant Professor Pyle.

Prerequisite, Veterinary 85.

87. **III.** Avian Pathology. — For seniors; juniors may elect. As stated under Courses 85 and 86.

2 3-hour laboratory periods, credit, 3.
Assistant Professor Pyle.

Prerequisite, Veterinary 86.

Zoölogy and Geology.

Professor Gordon, Mr. Foss.

The facts and principles of the sciences of zoölogy and geology have important applications in industry and the arts, and with those of their sister sciences form a body of knowledge of value and interest with which the educated man finds it necessary to gain a close familiarity. The elective courses in this department stand as offerings to students who wish to supplement their work in other departments, or who, for any reason, wish to enlarge their knowledge in either zoölogy or geology. Students are encouraged to consult the department about any courses which may be available to them, and which might prove necessary or helpful for any line of work they may wish to follow.

The building occupied jointly by the department of entomology and the department of zoölogy and geology has for the work in zoölogy and geology laboratories equipped with gas, compound microscopes and the accessories needed for study, research and demonstration in these subjects. There are two lecture rooms used jointly by the two departments. The Zoölogical Museum has a representative collection of several thousand specimens of animals, and is drawn upon for material illustrating the various courses.

Zoölogy.

Required Course.

25. **I.** General Principles and Teachings of Zoölogy. — Sophomores. An introductory course in which some of the basic features of animal structure, functions of organs and relations of animals to each other are emphasized. In the laboratory work an attempt is made to give first-hand knowledge of animals as a means to a better understanding of some modern conceptions that have grown out of zoölogical science, and with which the lectures deal. Not given, **I** term, in 1923–24.

2 class hours. 2 2-hour laboratory periods, credit, 4.
The Department.

Elective Courses.

26. **II.** Elements of Mammalian Anatomy. — Sophomores; juniors and seniors may elect. An introductory course which aims to acquaint the student with the positions, relations, names and functions of the principal organs and systems of organs of the mammalian body.

1 class hour. 2 2-hour laboratory periods, credit, 3.
The Department.

Prerequisite, Zoölogy 25.

50. **I.** Synoptic Invertebrate Zoölogy. — Juniors; seniors may elect. A course in which the student examines and compares representatives of the various phyla, classes and orders of the non-vertebrate animals.
1 class hour. 2 2-hour laboratory periods, credit, 3.
The Department.

Prerequisite, Zoölogy 25.

51. **II.** Synoptic Invertebrate Zoölogy. — Juniors; seniors may elect. Continuation of Course 50.
1 class hour. 2 2-hour laboratory periods, credit, 3.
The Department.

Prerequisite, Zoölogy 50.

52. **III.** Synoptic Invertebrate Zoölogy. — Juniors; seniors may elect. Continuation of Course 51.
1 class hour. 2 2-hour laboratory periods, credit, 3.
The Department.

Prerequisite, Zoölogy 51.

54. **II.** Elements of Microscopic Technique and Histology. — Juniors; seniors may elect. The student is taught the usual methods of preparing material for microscopic examination, including embedding in paraffin and celloidin, sectioning, and differentiation by stains. Supplemented by a microscopic study of selected normal animal tissues in connection with their physiological properties.
1 class hour. 2 2-hour laboratory periods, credit, 3.
The Department.

75. **I.** Special Zoölogy. — Juniors, seniors and graduates may apply for such special work as they are qualified to undertake.
1 class hour. 2 2-hour laboratory periods, credit, 3.
The Department.

76. **II.** Special Zoölogy. — Same as Course 75.
1 class hour. 2 2-hour laboratory periods, credit, 3.
The Department.

77. **III.** Special Zoölogy. — Same as Course 75.
1 class hour. 2 2-hour laboratory periods, credit, 3.
The Department.

79. **III.** Ornithology. — A study of the taxonomic characters, distribution and habits of birds.
1 class hour. 2 2-hour laboratory periods, credit, 3.
The Department.

Geology.

27. **III.** General Geology. — Sophomores; juniors and seniors may elect. A course in the physical aspects of geology, dealing with the origin, arrangement and manifold changes of the materials composing the earth's crust. Excursions by arrangement.
3 class hours. 2 2-hour laboratory periods, credit, 5.
Professor Gordon.

DIVISION OF THE HUMANITIES.

Professor Lewis.

Economics and Sociology.

Professor Lewis, Professor Sims.

[Heavy-faced type indicates the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

The courses in economics and sociology are planned with the purpose of giving the student that knowledge and understanding of the important factors and problems in this field of study and life which every active citizen and educated man ought to have.

Required Course.

25. **I.** Introduction to Economic Principles and Problems. — For description of course see Course 51, **I.**
3 class hours. 6 study hours, credit, 9.

Elective Courses.

26. **II.** Civilizations, Ancient and Modern. — For sophomores; others may elect. The evolutionary origin and history of man; characteristics of primitive man, departure from the animal status and beginnings of civilization; origin and development of industries, arts and sciences; the evolution of languages, warfare, migrations and social institutions; a study of the powerful natural and human forces that have brought man from the early stages to modern development; characteristic features of the leading civilizations and races of ancient and modern times; beneficial and dangerous factors in American life in view of the history of human civilization.
5 class hours. Credit, 5.

50. **II.** Business and Industry. — For juniors and seniors. The forms, organization, administration and labor problems of business. Methods of organizing, financing and administering corporations and partnerships; forms of business administration, wholesaling, jobbing, retailing, advertising, credits and collections; systems of industrial remuneration for wage earners, co-operation and preserving industrial peace; problems concerned with protective legislation for workmen and employers, sweated industries, prison labor, child labor and industrial education.
5 class hours. Credit, 5.

51. **I.** Introduction to Economic Principles and Problems. — For juniors. Definitions of economic terms, such as wealth, capital, value, etc.; factors of production, exchange and consumption; principles of economic production, supply and demand, diminishing returns, division of labor, productive organization, concentration of capital and labor, trust and monopoly problems, public control of production and distribution; principles of exchange, theories of value, money and its problems; international trade, tariff and free trade theories, American merchant marine, reciprocity, and trade treaties; forms of income, wages, interest, rent, profits and the forces which govern them; principles of spending, economy, luxury, conservation of individual and national resources; principles and agencies for saving, investments, banks, building associations, insurance of all kinds; schemes for social organization; socialism, communism, industrial democracy. Textbook and readings.
5 class hours. Credit, 5.

75. **I.** Social Institutions and Social Reforms. — For seniors; juniors by permission. Social institutions, such as the family, the State, property, religions; and such current problems as eugenics, race suicide, divorce, crime and delinquent classes, prison reform, prevention and treatment of dependents and defectives, poverty, its causes and preventions; constructive modern social reform movements for insurance of wage earners, protection of childhood, assurance of safety, health and play time for all classes. The correctional and charitable institutions of Massachusetts are studied in considerable detail.
5 class hours. Credit, 5.
Professor Sims.

77. **III.** Public Finance, Taxation, Money and Banking. — For seniors. Systems and problems of taxation as they are found in Europe and America; objects for spending public revenue; public debts and methods of organizing them; systems of money and currency problems of America; types, methods and functions of banks; economic and financial crises and depressions in the United States; modern war finance. Readings and lectures.
5 class hours. Credit, 5.

History and Government.

Required Course.

25. **I.** American Government. — A study of the structure and operation of the machinery of our government; also a study of the history of its development from its inception to the present day.
3 class hours. 5 study hours, credit, 8.

Elective Courses.

50. **III.** Government. — For juniors; seniors may elect. Forms and working methods of the governments of Great Britain, Germany, France, Russia, Switzerland, New Zealand and Canada; historic types and theories of government; forms and methods of Federal, State and local governments in America; progress and problems of democracy and new reform movements in organization and administration; new tendencies towards social legislation and extension of governmental control.
5 class hours. Credit, 5.

54. **I.** Modern European History. — Juniors; seniors may elect. The modern history of the principal countries of Europe, especially the great movements and revolutions that developed the nations up to the present generation.
3 class hours. Credit, 3.

79. **II.** European History Since 1870. — For seniors; juniors may elect. The Franco-Prussian War and the formation of the German Empire, the unification of Italy, the Third French Republic, European Expansion in the East, the Russo-Japanese War, and the origin, events and probable results of the War of 1914. While a continuation of Course 54, this course will be complete in itself, and may be elected by those who have had no history training. Its aim is to provide the basis for an understanding of present-day conditions, and for an intelligent participation in world affairs.
3 class hours. Credit, 3.

Languages and Literature.

Professor Lewis, Professor Patterson, Professor Mackimmie, Professor Ashley, Assistant Professor Prince, Assistant Professor Rand, Miss Goessmann, Mr. Thissell, Mr. Bögholt.

English.

Required Courses.

1. **I.** 2. **II.** 3. **III.** English. — Freshmen. Composition. Intended to teach straight thinking, sound structure, clear and correct expression. Lectures, recitations, theme writing and conferences.
3 class hours, 5 study hours. Credit, 8, **I, II** terms.
3 class hours, 6 study hours. Credit, 9, **III** term.
Professors Patterson, Prince, Rand and Mr. Bögholt.

25. **I.** English. — Sophomores. A general reading course in English literature.
2 class hours, 4 study hours. Credit, 6.
Professor Patterson and Miss Goessmann.

26. **II.** English. — Sophomores. A general reading course in English literature.
2 class hours. Credit, 2.
Professor Patterson and Miss Goessmann.

27. **III.** English. — Sophomores. A general reading course in English literature.
2 class hours. Credit, 2.
Professor Patterson and Miss Goessmann.

28. **I.** English. — English composition, oral and written.
1 class hour, 2 study hours. Credit, 3.
Professors Patterson, Prince, Rand and Mr. Bögholt.

Elective Courses in English Language and Literature.

50. **I.** English Poetry of the Romantic Period (1923–24). — Alternates with Course 53. For juniors; seniors may elect. A course in history, appreciation and understanding. Some of the writers studied are Gray, Goldsmith, Burns, Scott, Wordsworth, Coleridge, Byron, Keats and Shelley.
3 class hours. Credit, 3.
Professor Patterson.

51. **II.** English Poetry in the Nineteenth Century (1924–25). — Alternates with Course 54. For juniors; seniors may elect. In general, this course is like Course 50. Tennyson, Browning, Mrs. Browning, Arnold, Clough, the Rossettis, Morris, Swinburne and others.
3 class hours. Credit, 3.
Professor Lewis.

57. **III.** English Poetry in the Nineteenth Century (1924–25). — Alternates with Course 58. For juniors; seniors may elect. As stated under Course 51.
3 class hours. Credit, 3.
Professor Lewis.

52. **III.** English Writers from Milton to Pope. — For juniors; seniors may elect. A survey course that emphasizes the leading writers, literary currents and the

thought of the period. Some of the writers studied are Milton, Dryden, Addison, Swift and Pope.
3 class hours. Credit, 3.
Professor PATTERSON.

53. **I.** ENGLISH PROSE OF THE ROMANTIC PERIOD (1924–25). — For juniors; seniors may elect. A course in English prose paralleling Course 50. Some of the writers studied are Goldsmith, Coleridge, Lamb, DeQuincey and Hazlitt.
3 class hours. Credit, 3.
Professor PATTERSON.

54. **II.** ENGLISH PROSE IN THE NINETEENTH CENTURY (1923–24). — For juniors; seniors may elect. Parallels Course 51. Among the writers considered will be Macaulay, Carlyle, Ruskin, Newman and Arnold.
3 class hours. Credit, 3.
Professor LEWIS.

58. **III.** ENGLISH PROSE IN THE NINETEENTH CENTURY (1923–24). — For juniors; seniors may elect. As stated under Course 54. Alternates with Course 57.
3 class hours. Credit, 3.
Professor LEWIS.

55. **II.** AMERICAN LITERATURE. — For juniors; seniors may elect. A course in the chief American prose writers; among those studied being Franklin, Brockden, Brown, Irving, Cooper, Poe, Hawthorne, Emerson, Thoreau, Lowell, Holmes, Parkman.
3 class hours. Credit, 3.
Assistant Professor PRINCE.

56. **III.** AMERICAN LITERATURE. — For juniors; seniors may elect. A course in the chief American poets; among those studied being Freneau, Bryant, Poe, Emerson, Longfellow, Whittier, Holmes, Lowell, Whitman, Lanier.
3 class hours. Credit, 3.
Assistant Professor PRINCE.

60. **I.** THE LITERATURE OF RURAL LIFE. — For juniors; seniors may elect. A critical and appreciative study of writers, both in prose and poetry, who have interpreted nature from the viewpoint of the lover of country life, and those who have idealized agriculture, horticulture and other rural pursuits, together with those who have upheld as an ideal the development of a rural environment in cities.
3 class hours. Credit, 3.
Miss GOESSMANN.

61. **II.** THE LITERATURE OF RURAL LIFE. — For juniors; seniors may elect. As stated under Course 60.
3 class hours. Credit, 3.
Miss GOESSMANN.

Prerequisite, English 60.

65. **I.** ADVANCED COMPOSITION. — For juniors; seniors may elect. Advanced work in expository writing, based upon specimens by contemporary authors and upon the personal experience of the student. Particular attention is given to organization, diction and style.
3 class hours. Credit, 3.
Assistant Professor RAND.

66. **II.** Advanced Composition. — For juniors; seniors may elect. The preparation of theses and similar manuscripts upon subjects selected by the student. The foundation of this course lies in an orderly accumulation of material followed by an intelligent and readable interpretation of its significance.
3 class hours. Credit, 3.
Assistant Professor Rand.

67. **III.** Advanced Composition. — For juniors; seniors may elect. Work in journalistic and fictional narrative with supplementary reading.
3 class hours. Credit, 3.
Assistant Professor Rand.

75. **III.** Prose Fiction. — The short story or the novel. For seniors; juniors may elect. Readings, reports and discussions. Not offered in 1923–24.
3 class hours or library equivalents. Credit, 3.

79. **II.** Shakespeare. — For seniors; juniors may elect. A cursory survey of the origin and rise of English drama is followed by the reading of about fifteen of Shakespeare's plays, selected to indicate the evolution of the dramatist and to emphasize the various phases of his art. Every attempt is made to deepen the student's appreciation of the personalities to be found in the plays, and of the beauty of the many memorable poetic passages.
3 class hours. Credit, 3.
Assistant Professor Rand.

80. **III.** Modern Drama. — For seniors; juniors may elect. This course traces the development of English drama from the time of the Restoration to the present day. The purpose of the course is to impart an intelligent and sympathetic interest in the theatre of the Twentieth Century.
3 class hours. Credit, 3.
Assistant Professor Rand.

Public Speaking.

Elective Courses.

50. **I.** Argumentation. — For juniors; seniors may elect. Presents the fundamental principles of argumentation as applied to oral and written discourse, and develops in the student power to handle argument convincingly and persuasively. Lectures, discussions of leading questions of the day, practice in brief-drawing and the writing of forensics. The course is recommended for those who desire to enter the intercollegiate debates.
3 class debates. Credit, 3.
Assistant Professor Prince.

Prerequisite, Public Speaking 1, 2 or 3.

51. **II.** Occasional Oratory. — For juniors; seniors may elect. A study of the principles and the practice of formal oratory; the preparation and delivery of one original oration; prescribed reading in oratory. The course is recommended for those who wish to enter the Flint Contest.
3 class hours. Credit, 3.
Assistant Professor Prince.

Prerequisites, Public Speaking 1, 2 or 3.

French and Spanish.

Professor MACKIMMIE, Mr. THISSELL.

The aim of the courses in French and Spanish is to give the student a practical knowledge of these languages for the purpose of wider reading and research, to introduce him to some of their treasures in art and science, and through the literature to acquaint him with the people. In the elementary courses as much time as possible is given to oral work, to develop a speaking, as well as a reading, knowledge of the tongue.

FRENCH.

Required Courses.

1. **I.** 2. **II.** 3. **III.** ELEMENTARY FRENCH. — Freshmen; open upon arrangement to other students. The essentials of grammar are rapidly taught and will be accompanied by as much reading as possible. Required of freshmen presenting German for entrance who do not continue that language and have not studied French.
3 class hours, 6 study hours. Credit, 9, **I, III** terms.
3 class hours, 5 study hours. Credit, 8, **II** term.
Mr. THISSELL.

4. **I.** 5. **II.** 6. **III.** INTERMEDIATE FRENCH. — Freshmen; open upon arrangement to other students. Training for rapid reading. The reading of a number of short stories, novels and plays; composition, reports on collateral reading from periodicals and scientific texts in the library.
3 class hours, 6 study hours. Credit, 9, **I, III** terms.
3 class hours, 5 study hours. Credit, 8, **II** term.
Professor MACKIMMIE and Mr. THISSELL.
Prerequisite, required of freshmen who present two years of French for entrance and do not take German.

Elective Courses.

25. **I.** INTERMEDIATE FRENCH. — For sophomores; open upon arrangement to other students. Training for rapid reading; the reading of a number of short stories, novels and plays; readings from periodicals and scientific texts in the library.
3 class hours, 5 study hours. Credit, 8.
Mr. THISSELL.
Prerequisites, French 1, 2 and 3.

26. **II.** INTERMEDIATE FRENCH. — For sophomores; open upon arrangement to other students. As stated under Course 25.
3 class hours. Credit, 3.
Mr. THISSELL.
Prerequisite, French 25.

27. **III.** INTERMEDIATE FRENCH. — For sophomores; open upon arrangement to other students. As stated under Course 25.
3 class hours. Credit, 3.
Mr. THISSELL.
Prerequisite, French 26.

28. **I.** ADVANCED FRENCH. — For sophomores; open upon arrangement to other students. A reading course. Balzac's "Eugénie Grandet" and "Le Père Goriot," and other masterpieces of the nineteenth century; Brunetière's "Honoré de Balzac" and

Harper's "Masters of French Literature," readings in the library and written reports.
3 class hours, 5 study hours. Credit, 8.
Professor Mackimmie.

Prerequisites, French 4, 5 and 6.

29. **II.** Advanced French. — For sophomores; open upon arrangement to other students. As stated under Course 28.
3 class hours. Credit, 3.
Professor Mackimmie.

Prerequisites, French 4, 5 and 6.

30. **III.** Advanced French. — For sophomores; open upon arrangement to other students. General view of the histroy of French literature; Kastner and Atkins' "History of French Literature." Representative works of the important periods. Outside reading.
3 class hours. Credit, 3.
Professor Mackimmie.

Prerequisites, French 25 and 26, or French 28 and 29.

50. **I.** Scientific French. — For juniors; seniors may elect. Meets the requirements of individual students and equips them with exact English equivalents for the French scientific terms in their particular science. Word lists of scientific terms are required, and also weekly readings and reports from scientific works in the subject in which they are majoring. Several scientific works are read.
3 class hours. Credit, 3.
Mr. Thissell.

Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

51. **II.** Scientific French. — For juniors; seniors may elect. As stated under Course 50.
3 class hours. Credit, 3.
Mr. Thissell.

Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

52. **III.** Scientific French. — For juniors; seniors may elect. As stated under Course 50.
3 class hours. Credit, 3.
Mr. Thissell.

Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

75. **I.** French Literature. — For seniors; juniors may elect. The object of Courses 75, 76 and 77 is to give an introduction to recent movements in French literature. Course 75 deals with the drama, and plays by Augier, A. Dumas *fils*, Delavigne and other comtemporary dramatists.
2 class hours. Credit, 2.
Professor Mackimmie.

Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

76. **II.** French Literature. — For seniors; juniors may elect. The novel. Works by Flaubert, the De Goncourts and Zola are read. Written reports are required on outside reading.
2 class hours. Credit, 2.
Professor Mackimmie.

Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

77. **III.** French Literature. — For seniors; juniors may elect. Modern criticism. Sainte-Beuve, "Causeries du Lundi" (Harper) and works by Taine and Renan. Reference book, Lanson's "Histoire de la Littérature Française."
2 class hours. Credit, 2.
Professor Mackimmie.
Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

Spanish.

Elective Courses.

50. **I.** Elementary Spanish. — For juniors; seniors may elect. Open to other students upon arrangement. Grammar, with special drill in pronunciation; exercises in conversation and composition. Reading from a reader and selected short stories.
3 class hours. Credit, 3.
Professor Mackimmie.

51. **II.** Elementary Spanish. — For juniors; open to other students upon arrangement. As stated in Course 50.
3 class hours. Credit, 3.
Professor Mackimmie.
Prerequisite, Spanish 50.

52. **III.** Elementary Spanish. — For juniors; open to other students upon arrangement. As stated in Course 50.
3 class hours. Credit, 3.
Professor Mackimmie.
Prerequisite, Spanish 51.

75. **I.** Modern Spanish Authors. — Seniors. Reading from modern Spanish novel and drama. Translation of English into Spanish. Private reading.
2 class hours. Credit, 2.
Professor Mackimmie.
Prerequisite, Spanish 52.

76. **II.** Modern Spanish Authors. — Seniors. As stated in Course 75.
2 class hours. Credit, 2.
Professor Mackimmie.
Prerequisite, Spanish 75.

77. **III.** Modern Spanish Authors. — Seniors. As stated in Course 75.
2 class hours. Credit, 2.
Professor Mackimmie.
Prerequisite, Spanish 76.

German and Music.

Professor Ashley.

German.

The courses in German are intended to give the student a reading knowledge of the language and to introduce to him some of the masterpieces of German literature. To the student interested in pursuing advanced reading in scientific German, opportunity is given to do corollary reading in his major subject, in collaboration with the head of that department.

Required Courses.

1. **I.** 2. **II.** 3. **III.** Elementary German. — Freshmen; open upon arrangement to other students. Grammar, composition and reading. Especial attention is given to oral work in German and to translation of English into German. Required of those presenting French for entrance who do not continue that language and have not studied German.
3 class hours, 6 study hours. Credit, 9, **I, III** terms.
3 class hours, 5 study hours. Credit, 8, **II** term.
Professor Ashley.

4. **I.** 5. **II.** 6. **III.** Intermediate German. — Freshmen; open upon arrangement to other students. Selected works of Schiller, Heine and Goethe. Grammar review and advanced prose composition.
3 class hours, 6 study hours. Credit, 9, **I, III** terms.
3 class hours, 5 study hours. Credit, 6, **II** term.
Professor Ashley.

Prerequisite, required of freshmen who present two years of German for entrance and do not take French.

Elective Courses.

25. **I.** Intermediate German. — For sophomores; open upon arrangement to other students. Reading of such works as Sudermann's "Frau Sorge," "Wilhelm Tell," "Die Journalisten," etc. Grammar review.
3 class hours, 5 study hours. Credit, 8.

Prerequisites, German 1, 2 and 3.

26. **II.** Intermediate German. — For sophomores; open upon arrangement to other students. As stated under Course 25.
3 class hours. Credit, 3.

Prerequisite, German 25.

27. **III.** Intermediate German. — For sophomores; open upon arrangement to other students. As stated under Course 25.
3 class hours. Credit, 3.

Prerequisite, German 26.

28. **I.** Advanced German. — For sophomores; open upon arrangement to other students. Reading and studying of Goethe's most important literary productions.
3 class hours, 5 study hours. Credit, 8.
Professor Ashley.

Prerequisites, German 4, 5 and 6.

29. **II.** Advanced German. — For sophomores; open upon arrangement to other students. Development of the German novel; rapid reading of great novelists.
3 class hours. Credit, 3.
Professor Ashley.

Prerequisite, German 28.

30. **III.** Advanced German. — For sophomores; open upon arrangement to other students. As stated under Course 29.
3 class hours. Credit, 3.
Professor Ashley.

Prerequisite, German 29.

50. **I.** Scientific German. — For juniors; seniors may elect. Reading in German of modern magazine articles and works of a scientific nature. Different work assigned according to needs of individual students.
3 class hours. Credit, 3.
Professor Ashley.

Prerequisites, German 4, 5 and 6, or German 25, 26 and 27.

51. **II.** Scientific German. — For juniors; seniors may elect. As stated under Course 50.
3 class hours. Credit, 3.
Professor Ashley.

Prerequisite, German 50.

52. **III.** Scientific German. — For juniors; seniors may elect. As stated under Course 50.
3 class hours. Credit, 3.
Professor Ashley.

Prerequisite, German 51.

75. **I.** German Literature. — Seniors. Advanced language and literary study. Conducted entirely in German. Lectures on German literature and history; life, customs and travel in Germany. Collateral readings, including masterpieces of different epochs, such as "Niebelungenlied," Goethe's "Faust" and one modern typical drama.
3 class hours. Credit, 3.
Professor Ashley.

Prerequisites, German 28, 29 and 30.

76. **II.** German Literature. — Seniors. As stated under Course 75.
3 class hours. Credit, 3.
Professor Ashley.

Prerequisite, German 75.

77. **III.** German Literature. — Seniors. As stated under Course 75.
3 class hours. Credit, 3.
Professor Ashley.

Prerequisite, German 76.

78. **I.** Conversation and Composition. — For seniors; juniors may elect. Translating connected English into German. Reproducing outside readings in German orally in class.
1 class hour. Credit, 1.
Professor Ashley.

Prerequisites, German 4, 5 and 6, or German 25, 26 and 27.

79. **II.** Conversation and Composition. — For seniors; juniors may elect. As stated under Course 78.
1 class hour. Credit, 1.
Professor Ashley.

Prerequisite, German 78.

80. **III.** Conversation and Composition. — For seniors; juniors may elect. As stated under Course 78.
1 class hour. Credit, 1.
Professor Ashley.

Prerequisite, German 79.

Music.

Elective Courses.

50. **I.** History and Interpretation of Music. — For juniors; seniors may elect. History of music among the ancients; medieval and secular music; epoch of vocal counterpoint; development of monophony opera and oratorio; life and works of the greatest representatives of the classical school, — Bach, Händel, Haydn, Gluck and Mozart.
1 class hour. Credit, 1.
Professor Ashley.

51. **II.** History and Interpretation of Music. — For juniors; seniors may elect. A continuation of Course 50. The Romantic school; Beethoven, Schubert, Weber, Mendelssohn, Schumann, Chopin, Berlioz and Liszt; Wagner and the opera.
1 class hour. Credit, 1.
Professor Ashley.

52. **III.** History and Interpretation of Music. — For juniors; seniors may elect. The Modern school and Modern composers.
1 class hour. Credit, 1.
Professor Ashley.

DIVISION OF RURAL SOCIAL SCIENCE.

President Butterfield.

[Heavy-faced type indicates the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

Agricultural Economics.

Professor Cance, Assistant Professor Sawtelle, Mr. Yount.

Instruction in agricultural economics is designed to show that the agricultural industry justifies its existence chiefly as a supplier of food and raw textile materials for human consumption; that agricultural success is measured by production of values rather than by production of volume of agricultural products; that the goal of the farmer is the largest net profit over a long-time period; that agricultural production includes all processes from purchase of seed and fertilizer and preparation of seedbed until the product reaches the consumer, including collection, transportation, storage, financing, packing, handling and selling; that a knowledge of the business of agriculture and agricultural commerce is to-day more necessary than a knowledge of agricultural technique.

The work of this department is conducted by means of lectures, readings and research in both library and field. A catalogue, now containing some 12,000 cards, covering the various phases of agricultural economics, is maintained. The department is also supplied with a large collection of maps, charts and statistical reports on the prices and supply of agricultural products. A goodly number of regular reports of the Bureau of Markets and other divisions of the United States Department of Agriculture are available for the use of students. Two series of bound volumes of bulletins are kept in the department offices, with duplicate series in the college library; one series already contains 12 volumes on "Co-operation in Agriculture," and the other, 15 volumes on "Marketing of Farm Products."

Required Course.

26. **II.** Agricultural Industry and Resources. — Sophomores. A descriptive course dealing with agriculture as an industry and its relation to physiography, movement

of population, supply of labor, commercial development, transportation, public authority and consumers' demand. The principal agricultural resources of the United States are studied with reference to commercial importance, geographical distribution, present condition and means of increasing the value of the product and cheapening cost of production. Lectures, assigned readings, class topics and discussions.

4 class hours. 1 2-hour laboratory period, credit, 5.

Professor CANCE.

Elective Courses.

50. **I.** ELEMENTS OF AGRICULTURAL ECONOMICS. — For juniors; seniors may elect. Designed to accompany or follow the course in elements of economics. Deals with the economic principles underlying the welfare and prosperity of the farmer and those institutions upon which his economic success depends; the economic elements in the production and distribution of agricultural wealth; means of exchange; principles of rural credit; problems of land tenure and land values; taxation of farm property; and the maintenance of the economic status of the farmer. Lectures, text, readings, topics and field work.

5 class hours. Credit, 5.

Professor CANCE.

51. **III.** HISTORICAL AND COMPARATIVE AGRICULTURE. — For juniors; seniors may elect. A general survey of agriculture, ancient and modern; feudal and early English husbandry; the later development of English agriculture; the course of agriculture in the United States, with special emphasis on the development of agriculture in New England. An attempt is made to measure the influence of times, peoples and countries in producing different systems of agriculture, and to ascertain the causes now working to effect agricultural changes. Lectures, readings and library work. Students in education and rural journalism should find this course helpful.

5 class hours. Credit, 5.

Assistant Professor SAWTELLE.

52. **II.** CO-OPERATION IN AGRICULTURE. — For juniors; seniors may elect. The history, principles and business relations of agricultural co-operation. (1) A survey of the development, methods and economic results of farmers' organizations and great co-operative movements; (2) the business organization of agriculture abroad, and the present aspects and tendencies in the United States; (3) the principles underlying successful co-operative endeavor among farmers, practical working plans for co-operative associations, with particular reference to credit and purchase and the marketing of perishable products. Lectures, text, assigned readings and practical exercises.

5 class hours. Credit, 5.

Professor CANCE.

53. **III.** THE AGRICULTURAL MARKET. — For juniors; seniors and graduate students may elect. A study of the forces and conditions which determine the prices of farm products and the mechanism, methods and problems concerned with transporting, storing and distributing them. Supply and demand, course of prices, terminal facilities, the middleman system, speculation in agricultural products, protective legislation, the retail market and direct sales are taken up. The characteristics and possibilities of the New England market are given special attention. Lectures, readings, assigned studies and field work.

5 class hours. Credit, 5.

Professor CANCE.

75. **II.** RURAL AND BUSINESS LAW. — For seniors; juniors may elect. Land, titles, public roads, rights incident to ownership of live stock, contracts, commercial

paper and distinctions between personal and real property. Text, written exercises, lectures and class discussions.
5 class hours. Credit, 5.

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76. **II.** Transportation of Agricultural Products. — For seniors and graduate students; juniors may elect. The development of highway, waterway and railway transportation and its relation to the agricultural development of the country; the principles governing the operation and control of transportation agencies; present-day problems relating to the shipment of farm products, rates, facilities and services; methods of reducing wastes in transportation; the economics of the good roads movement and of motor transportation. Lectures, text and field work.
5 class hours. Credit, 5.
Professor Cance.

77. **I.** Problems in Agricultural Economics. — For seniors and graduate students; juniors may elect. An advanced course for those desirous of studying more intensively some of the economic problems affecting the farmer, such as: land problems, — land tenure, size of farms, causes affecting land values, private property in land, taxation of farm property; special problems, — cost of producing farm products, farm labor in New England, immigration, agricultural credit. Opportunity is given, if practicable, for field work, and students are encouraged to pursue lines of individual interest.
5 class hours. Credit, 5.
Professor Cance.

78. **III.** Agricultural Credit Facilities. — For seniors and juniors. Lectures, discussions and assigned readings on credit needs of farmers; the legitimate use of credit in the acquisition of land, and the production, storage and marketing of agricultural products; the development of national and State rural credit institutions and laws; the powers and methods of operation of credit institutions with reference to the supply of credit for agricultural purposes; the methods by which the individual may increase his credit standing and borrowing power; ways in which the present credit facilities may be increased.
3 class hours. Credit, 3.
Assistant Professor Sawtelle.

79. **I.** Agricultural Statistics. — For seniors, juniors and graduate students. The nature and sources of agricultural statistics, the methods of obtaining numerical facts, of analyzing and drawing conclusions from statistical data, and the methods of presenting in a true and forceful manner the statistical facts of the agricultural industry. Opportunity is given in the laboratory for practice in the use of statistical methods and processes, and to acquire experience in dealing with practical statistical problems. The application of statistics and statistical methods in the fields of agricultural economics, extension work, education, journalism and the business matters connected with farm operation is emphasized.
2 class hours. 3 2-hour laboratory periods, credit, 5.
Assistant Professor Sawtelle.

80. **I.** Seminar. — For seniors and graduate students. Research in agricultural economics and history; problems of New England agriculture. Library work and reports. If desirable some other topic may be substituted.
Hours to be arranged. 1 2-hour conference period, credit, 1 or 2.
The Department.

81. **II.** Seminar. — For seniors and graduate students. As stated in Course 80.
1 2-hour conference period, credit, 1 or 2.
The Department.

82. **III.** Seminar. — For seniors and graduate students. As stated in Course 80.
1 2-hour conference period, credit, 1 or 2.
The Department.

83. **I.** Salesmanship of Agricultural Products. — For seniors; juniors may elect. The course embraces a study of the principles and practices that are involved in the selling of goods and services. The application of these principles of salesmanship to the disposal of agricultural products is especially emphasized. Types of sales, motives for buying, securing interviews, types of prospects, preparation of sales talks, meeting objections and excuses, and sales demonstrations by students and the instructor are included.
2 class hours. Credit, 2.

84. **III.** Advertising Agricultural Products. — For seniors; juniors may elect. A course dealing with the application of the principles of advertising to agricultural products. A study of the nature of advertising, the economics of advertising, the use of media, copy, psychology as applied to advertising, layout, the advertising campaign, advertising agency, etc., is made. The solution of practical problems to emphasize different phases of advertising is required by students.
2 class hours. Credit, 2.

85. **II.** Agricultural Prices. — For seniors and graduate students. A study of the prices of agricultural products and other commodities which are of importance in the agricultural industry. Limited to five students.
2 or 3 2-hour laboratory periods, credit, 2 or 3.
Assistant Professor Sawtelle.

86. **III.** Agricultural Prices. — For seniors and graduate students as stated in Course 85. Limited to five students.
2 or 3 2-hour laboratory periods, credit, 2 or 3.
Assistant Professor Sawtelle.

87. **III.** Foreign Trade in Agricultural Products. — For seniors and graduates; juniors may elect. A general course embracing a study of the principles and practices of international trade and the foreign commerce of the United States, particularly with reference to agricultural products. The development and present status of foreign trade in agricultural products, trade relations with foreign nations, the agencies and practices of foreign trade, foreign trade salesmanship and advertising, the status of New England with reference to foreign trade are some of the topics which will be presented. The work in the course will also include a personal study of special features of foreign trade and of the trade importance of specific subjects. Textbook, class discussions and class topics.
3 class hours. Credit, 3.

Agricultural Education.

Professor Welles, Professor Glick, Mr. Heald,[1] Miss Hamlin.

The primary aim of the department is to train students for service in some form of educational work. Students desiring state approval as teachers of agriculture or related subjects should confer with the head of the department as early as possible to insure a desirable range of preparation. They should also become acquainted with the State Agent for Agricultural Teacher-Training who approves candidates for positions in agricultural departments and special schools.

The department seeks to be of the greatest possible service to students who are prepared to teach and whose scholastic standing and qualifications generally seem to make them suitable candidates for positions. Students who major in other departments but expect to teach should consult this department regarding the educational courses best suited to their purposes.

The department recommends to the State Department of Education such graduates of the college as are entitled to receive the high school teachers' term certificate.

The department is thoroughly equipped for its work with classrooms, reference material, etc. The offices are in close proximity to the classroom.

Required Course.

26. **II.** Agricultural Opportunities for Women. — For sophomores. Designed to show the woman who is interested in agriculture what opportunities there are for her in that field, and how she may best take advantage of them. The types of agricultural work for which women are best adapted are discussed. A study is made of some of the special problems which confront the woman farmer, and her best ways of solving them.
2 class hours. Credit, 2.
Miss Hamlin.

Elective Courses.

51. **I** and **II.** Principles and Methods of Teaching. — For juniors; seniors may elect. This course is intended primarily for students who expect to teach. Others should consult the head of the department before registering. It consists of a study of the general principles of teaching applied to particular cases. These cases are gathered in part by the class during assigned observation visits to classes in session in public schools and in part from the reports of the work of teachers. The attempt to solve the problems presented by these cases furnishes opportunity for fixing the ideas in methods. A good text in methods for secondary schools is the basis of the course.
5 class hours. Credit, 5.
Professor Welles.

52. **III.** History and Philosophy of Education. — For juniors; seniors may elect. A study of educational history in modern times, educational movements in the United States and their bearing on national aims and ideals, with special emphasis on education for a democracy.
5 class hours. Credit, 5.
Professor Glick.

55. **I.** General Psychology. — For juniors; seniors and graduates may elect. This is a basic course for those anticipating further study in psychology as well as a practical

[1] State Agent for Agricultural Teacher-Training representing the State Department of Education in the administration of vocational education acts.

and cultural course for those who can take only one course in this field. It deals with the fundamental principles of psychology; the evolution of mind in animals and man; various types and products of social organizations; abnormal psychology including hypnotism, dreams, mental disorders, etc.

5 class hours. Credit, 5.

Professor GLICK.

56. **II.** EDUCATIONAL PSYCHOLOGY. — For juniors; seniors and graduates may elect. It is a direct application of psychology to the field of education and is a basic course for both general and specific methods. The course deals with the original nature of the child, the psychology of learning, individual differences, transfer of training, mental tests, etc. Intended primarily for prospective teachers, but open to others who are sufficiently interested.

5 class hours. Credit, 5.

Professor GLICK.

Prerequisite, Agricultural Education 55 or consent of the instructor.

75. **II.** PRINCIPLES OF SECONDARY EDUCATION. — For seniors; juniors may elect. This is a study of the American high school, both junior and senior. It is designed to acquaint the student with the aims and objectives of the high school and the factors upon which the realization of these aims depend. Some of the specific topics included in the study are financial support, course of study, qualifications of teachers and recent tendencies and policies in secondary education.

3 class hours. Credit, 3.

Professor GLICK.

76. **I** and **III.** SPECIAL METHODS IN TEACHING VOCATIONAL AGRICULTURE. — For seniors; juniors and others qualified may elect. Students must consult the head of the department before registering for this course. The work consists of outlining lessons and projects for the teaching of agriculture or related subjects in agricultural schools or departments; the application of principles of vocational education as embodied in the Smith-Hughes Act and other legislation relative to agricultural education; the necessary adjustments relating to the school, community and administrative officials; assigned study of agricultural departments in operation, etc.

5 class hours. Credit, 5.

Professor WELLES.

77. **III.** METHODS IN EXTENSION TEACHING. — For seniors; juniors and others qualified may elect. The nature of this course requires that only those who are definitely interested be admitted. Candidates must consult the head of the department before registering. The course consists of a survey of the field of extension work and the methods by which this work is accomplished. The specific lines dealt with are those of the county agent, boys' and girls' club leader, county demonstration agent and agricultural specialist. The administration of county, state and federal extension service is included in the discussions. Some time will be required of each student in field observation of extension work. The course will be conducted jointly by members of the Extension Service staff and the department of Agricultural Education.

3 class hours. Credit, 3.

Professor WELLES and EXTENSION SERVICE STAFF.

80. **I, II** and **III.** SUPERVISED TEACHING. — (Includes apprentice, practice and observation teaching.) Primarily for seniors; juniors and others qualified may be admitted by arrangement. Under certain conditions a student may absent himself from college during one term of his junior or senior year for supervised teaching. Such a procedure is particularly desired for those who are preparing to teach agriculture and

is in accordance with the state plan which specifies the apprentice method of training. For detailed information consult the head of the department.

Opportunities for practice teaching are sought on the campus and in nearby high schools for those who cannot absent themselves for a term of apprentice teaching. A limited amount of observation practice is permissible. Besides teaching a student is required to pursue a course of professional reading bearing upon the subject he is teaching or observing. In all cases he is required to make detailed teaching plans covering the subject-matter of the lessons and to outline the supporting projects. The amount of credit depends upon the number, character and length of teaching exercises and conferences. Scheduled by arrangement.

Credit, 1 to 5.
The DEPARTMENT.

81. **III.** SEMINAR IN METHODS OF TEACHING. — Open to seniors majoring in Agricultural Education; graduate students and others by arrangement. This is an opportunity for those definitely intending to teach to make further studies in special lines other than agriculture, which is provided for in Agricultural Education 76. These include methods in college teaching, special methods in science, etc.
1 2-hour conference period per week. Credit, 1 or 2.
Professor WELLES.

Prerequisites, Agricultural Education 51 and 56 or equivalents.

83. **III.** SEMINAR IN APPLIED PSYCHOLOGY. — Open to seniors majoring in Agricultural Education; graduate students and others by arrangement. It is intended for those who desire to follow the application of psychology to special fields such as salesmanship, public office, extension work, education, business, advertising, etc.
1 2-hour conference period per week. Credit, 1 or 2.
Professor GLICK.

Prerequisites, Agricultural Education 55 and 56 or 85.

85. **I.** VOCATIONAL PSYCHOLOGY. — For seniors and graduates; juniors may elect. A study of psychology as applied to vocational work other than education, such as salesmanship, advertising, medicine, law, vocational tests, selection and management of employees, etc.
3 class hours. Credit, 3.
Professor GLICK.

Prerequisite, Agricultural Education 55 or consent of instructor.

Rural Sociology.

Professor PHELAN, President BUTTERFIELD, Professor SIMS, Mr. NOVITSKI.[1]

The courses in rural sociology are designed for two purposes: first, to give students an appreciation of the general problems of country life; second, to afford a definite training for students who wish to take up some specific form of social service. In the last ten years rural sociology has been introduced as a subject into more than 50 per cent of the agricultural schools and colleges. There is a good demand for teachers, and an increasing opportunity in other directions in this subject. The courses afford the student an opportunity to pursue graduate as well as undergraduate work. The library of the college is unusually well equipped with rural sociological material.

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[1] On leave of absence.

Required Course.

27. **III.** Elements of Rural Sociology. — Sophomores. A broad survey of the field of rural sociology, including such topics as the origin of rural sociology, its methods and problems; relation of sociological to the scientific and technical aspects of agricultural problems; the development of the rural community in New England and the west, religious, educational and social ideals of rural people; characteristics and influence of the rural environment, the movement of the rural population, the effects of immigration; rural institutions, the school, the church, local government, effects of modern conditions of life on rural institutions; rural organization; problems of progress, and analysis of the needs of rural life in its further development. Lectures, readings and essays on assigned topics.

3 class hours. Credit, 3.

Professor Sims.

Elective Courses.

50. **I.** Social Condition of Rural People. — For juniors; seniors may elect. A. The rural status: composition of the rural population, nature, extent and causes of diseases and accidents, health agencies of control; extent and causes of rural delinquency and dependency, conditions of temperance, of morality and family integrity; child labor, women's work and position; standard of living, size of family; cultural ideals; community consciousness and activity; standards of business conduct and of political ethics.

B. Rural social psychology: characteristics of the rural mind, character of hereditary and environmental influence; nature and effect of face-to-face groups; fashion, conventionality, custom, character of discussion and of public opinion.

3 class hours. Credit, 3.

Professor Sims.

51. **II.** Rural Government. — For juniors; seniors may elect. A general survey of the development of rural government in the United States, origin of the New England town, its influence upon the west, county government, the influence of the farmer in legislation, good roads movement, credit facilities, taxation, boards of agriculture, agricultural colleges and experiment stations in relation to rural welfare; national government; a general survey of political organizations and movements among farmers in the United States and foreign countries and their influence in shaping legislation; relation of the Department of Agriculture, postal system, the various national commissions and agencies to rural welfare. Lectures, readings, written exercises on assigned topics.

3 class hours. Credit, 3.

Professor Sims.

52. **III.** Rural Organization. — For juniors; seniors may elect. A study of the organized agencies by which rural communities carry on their various forms of associated life, particularly a study of the ways by which the domestic, economic, cultural, religious and political institutions contribute to rural betterment; principles underlying leadership, qualifications of the paid leader and the lay leader; the field of rural social service, national, State and local, preparation and opportunity for service; rural community building, a study of organized ways and means by which aid is given local communities. The method, scope and history of local, State and national associations formed about some farm product, their influence in forming class consciousness and in shaping agrarian legislation; need of federation. Lectures, readings and essays on assigned topics.

3 class hours. Credit, 3.

Professor Sims.

76. **I.** Field Work in Rural Sociology. — For seniors; juniors may elect. Designed to meet the needs of students who wish to do some constructive work in rural social service while still in college. The work is carried on in co-operation with the various college agencies engaged in rural service. Any project for which credit in this course is to be asked must first have the approval of the head of the department.

From 2 to 6 laboratory hours, credits, 1 to 3.
Professor Phelan.

Prerequisites, Rural Sociology 27 and 52.

77. **II.** Rural Social Surveys. — For seniors; juniors may elect. A careful study of the theory and function of statistics, the limitations and difficulties in the use of statistics, the interpretation of statistical data, various methods of graphic representation; a study of surveys, kinds and use, method of gaining information, the basis for conclusions, value of information gained. Text and lectures.

3 class hours. Credit, 3.
Professor Sims.

79. **I.** Seminar. — Enrollment is limited to students who have had at least three courses in rural sociology, and to students majoring in the subject.

Credits, 1 to 3.
Professor Phelan.

80. **II.** Seminar. — Enrollment is limited to students who have had at least three courses in rural sociology, and to students majoring in the subject.

Credits, 1 to 3.
Professor Phelan.

81. **III.** Seminar. — Enrollment is limited to students who have had at least three courses in rural sociology, and to students majoring in the subject.

Credits, 1 to 3.
Professor Phelan.

Rural Home Life.

Miss Skinner, Miss Bartley.

The Department of Rural Home Life offers elective courses for students majoring in other departments of the college. Fundamentally this training is such as will help young women to be better prepared to adjust themselves readily to their environment in the home and in the community, and to help them realize their responsibility as good homemakers and as good citizens.

The food laboratory, located in the entomology building, is fitted with individual desks (cabinet form) to hold utensils and materials for each student. Each table is equipped with gas stoves. A storage cabinet is provided with bins for supplies and cupboard space for large utensils and illustrative material. This room is well lighted and pleasant. The clothing laboratory is located in the Adams House. The equipment consists of sewing machines, cabinets, work tables, cutting tables, electric irons, dress forms and a collection of materials illustrating the production of textiles for clothing and household use.

Required Courses.

1. **I.** Introduction to Home Economics. — Freshmen women. Lectures on the history and evolution of the home; social customs and their value in family relationships; healthful and suitable care of the wardrobe; principles of nutrition as applied to the student's life; the student's budget, and the keeping of personal accounts.

2 class hours. Credit, 2.
Miss Skinner.

Elective Courses.

25. **I.** 26. **II.** 27. **III.** TEXTILES AND CLOTHING. — Sophomores. The selection and purchase of suitable materials, their character, cost and durability. Appropriateness and simplicity in dress. Practical work in hand and machine sewing, drafting and designing of patterns, the care and repair of clothing. The work of the fall term is required of all sophomore women.
1 lecture. 1 2-hour laboratory period, credit, 3, **I** term.
1 lecture. 2 2-hour laboratory periods, credit, 3, **II, III** terms.
Miss BARTLEY.

50. **I.** FOODS AND COOKERY. — Juniors. — An introduction to the subject of foods in their scientific and economic aspects of selection, preparation and use.
2 class hours. 2 2-hour laboratory periods, credit, 4.
Miss SKINNER.

51. **II.** FOODS AND COOKERY. — Juniors. A continuation of Course 50, with stress upon meal planning and serving.
2 class hours. 2 2-hour laboratory periods, credit, 4.
Miss SKINNER.

52. **III.** ADVANCED FOOD STUDY. — Juniors. — A study of food materials in their relation to the daily dietary of families under various conditions; a consideration of dietary standards as influenced by age, sex and occupation; a comparative study of the nutritive values of usual foods.
2 class hours. 2 2-hour laboratory periods, credit, 4.
Miss SKINNER.

76. **II.** HOUSEHOLD MANAGEMENT (1923–24). — Juniors and seniors. The application of the principles of scientific management to the household, and the elements of successful home making. The family income, cost of living, household accounts, the budget and its apportionment. The responsibility of the woman to her family and the community in establishing right standards of living. Given in alternate years.
4 class hours. Credit, 4.
Miss SKINNER.

78. **III.** HOME NURSING (1923–24). — Juniors and seniors. A study of the care of the family health; simple diseases and their prevention; the care of young children and invalids; first aid to the injured. Given in alternate years.
3 class hours. Credit, 3.
Miss SKINNER.

GENERAL DEPARTMENTS.

[Heavy-faced type indicates the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

Military Science and Tactics.

Major HERMAN KOBBE, Cav. (D. O. L.), U. S. A.; Captain DWIGHT HUGHES, Jr., Cav. (D. O. L.), U. S. A.; Captain THOMAS BRADY, Jr., Cav. (D. O. L.), U. S. A.; Captain JAMES V. V. SHUFELT, Cav. (D. O. L.), U. S. A.; Technical Sergeant JOHN J. LEE, U. S. A., Retired; Technical Sergeant JAMES A. WARREN, Cav. (D. E. M. L.), U. S. A.; and a detachment of enlisted men of the United States Army.

Under act of Congress (July 2, 1862) military instruction under a regular army officer was required in this college of all able-bodied male students. Under act of Congress June 3, 1916, as amended by act of Congress Sept. 8, 1916, there was established at this college in April, 1917, an infantry unit of the Reserve Officers' Training Corps.

Following the World War and an act of Congress (July 9, 1918) the Reserve Officers' Training Corps is in operation under the regulation of the War Department, administered by the president of the college and the professor of military science and tactics.

Beginning with the fall term, 1920–21, the infantry unit of the Reserve Officers' Training Corps was converted into a cavalry unit.

The primary object of the Reserve Officers' Training Corps is to provide systematic military training at civil educational institutions, for the ultimate purpose of qualifying selected students of such institutions as reserve officers in the military forces of the United States. It is intended to attain this object during the time the students are pursuing their general or professional studies, with the least practicable interference with their civil careers, by employing methods designed to fit men physically, mentally and morally for pursuits of peace as well as war.

All candidates for a degree in a four-year course must take for two years at least three hours a week of military training.

Students in their junior and senior years, who are approved by the president and the professor of military science and tactics, may take the advanced course if they so elect. The advanced course consists of at least five hours per week and a summer camp of about six weeks during the summer vacation, between the junior and senior years. Students taking this course are paid by the Federal government at a rate to be fixed by the Secretary of War, not to exceed the value of the army ration. The rate now fixed is 40 cents per day, which amounts to about $146 per year. Students graduating in the advanced course are eligible for commissions in the Officers' Reserve Corps, *but are not required to accept such commissions if offered.*

The required uniform is of olive drab woolen cloth, and is furnished for the use of the students by the Federal government without cost. It is worn by all cadets when on military duty. New uniforms are furnished each year.

The course for cavalry units of the Reserve Officers' Training Corps includes theoretical and practical instruction in all phases of cavalry work, so distributed over the four-year college course as to qualify students at the end of the freshman year as privates of cavalry; at the end of the sophomore year as non-commissioned officers of cavalry; and upon graduation as reserve officers. The instruction in this department covers cavalry drill, cavalry weapons, — *i.e.*, rifle, pistol, saber, automatic rifle and machine gun, — map reading and military sketching, minor tactics, equitation, etc. The course in equitation includes cross country riding and instruction in polo. So far as season and weather permit, instruction is of a practical nature out of doors.

Required Courses.

1. **I.** — Freshmen. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 3.

The Professor of Military Science
and Tactics, and Assistants.

2. **II.** — Freshmen. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 3.

The Professor of Military Science
and Tactics, and Assistants.

3. **III.** — Freshmen. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 3.

The Professor of Military Science
and Tactics, and Assistants.

25. **I.** — Sophomores. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 3.

THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

26. **II.** — Sophomores. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 3.

THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

27. **III.** — Sophomores. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 3.

THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

Elective Courses.

50. **I.** — Juniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 5.

THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

51. **II.** — Juniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 5.

THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

52. **III.** — Juniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 5.

THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

75. **I.** — Seniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 5.

THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

76. **II.** — Seniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 5.

THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

77. **III.** — Seniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

Credit, 5.

THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

Physical Education and Hygiene.

Professor Hicks, Assistant Professor Gore, Mrs. Hicks, Mr. Grayson, Mr. Gordon, Mr. Derby.

The purpose of the courses offered by this department is to provide active exercise and to instruct every student how to care for his health and maintain his physical condition while carrying on his college course.

The equipment consists of the Alumni Athletic Field, which has room for two football fields, a quarter-mile cinder track with a 220 straightaway, and the baseball diamond; and also the old field for class football and baseball, two tennis courts, and the drill hall floor for basket ball. For several years the drill hall floor was used for class work in gymnastics, but its condition has become so bad that this has been discontinued. During the winter months a hockey rink is provided on the college pond.

[All undergraduate male students are given a physical examination upon entering.]

Men.

Required Courses.

1. **I.** Hygiene. — Freshmen. Lectures on personal hygiene.
1 class hour. Credit, 1.
Professor Hicks.

2. **I.** Recreation. — Freshmen. Outdoor games.
2 laboratory hours, credit, 2.
The Department.

3. **III.** Recreation. — Freshmen. Outdoor games.
2 laboratory hours, credit, 2.
The Department.

7. **I.** 8. **II.** 9. **III.** Recreation. — Military substitute for freshman men.
3 1-hour laboratory periods, credit, 3.
The Department.

25. **I.** Recreation. — Sophomores. Outdoor games.
2 laboratory hours, credit, 2.
The Department.

26. **III.** Recreation. — Sophomores. Outdoor games.
2 laboratory hours, credit, 2.
The Department.

30. **I.** 31. **II.** 32. **III.** Recreation. — Military substitute for sophomore men.
3 1-hour laboratory periods, credit, 3.
The Department.

Elective Course.

77. **III.** Training Course. — Seniors. Election by permission only. History of physical education and supervision of athletics.
1 class hour. Credit, 1.
Professor Hicks.

Women.

Required Courses.

4. **I.** Recreation. — Freshmen. Outdoor games.
3 laboratory hours, credit, 3.
Mrs. Hicks.

5. **II.** Gymnastics. — Freshmen. Dancing, Swedish games, etc.
3 laboratory hours, credit, 3.
Mrs. Hicks.

6. **III.** Recreation. — Freshmen. Outdoor games.
3 laboratory hours, credit, 3.
Mrs. Hicks.

27. **I.** Recreation. — Sophomores. Outdoor games.
3 laboratory hours, credit, 3.
Mrs. Hicks.

28. **II.** Gymnastics. — Sophomores. Dancing, Swedish games, etc.
3 laboratory hours, credit, 3.
Mrs. Hicks.

29. **III.** Recreation. — Sophomores. Outdoor games.
3 laboratory hours, credit, 3.
Mrs. Hicks.

Elective Courses.

50. **II.** Gymnastics. — Juniors. Dancing, Swedish games, etc.
3 laboratory hours, credit, 1.
Mrs. Hicks.

76. **II.** Gymnastics. — Seniors. Dancing, Swedish games, etc.
3 laboratory hours, credit, 1.
Mrs. Hicks.

THE LIBRARY.

The general college library consists of all books belonging to the college, including the library of the Experiment Station and all divisional and departmental collections of books. The main collection now occupies the entire building, which was originally intended to serve the purposes of both chapel and library. A dictionary card catalogue is intended ultimately to cover all material in the general college library, which now comprises approximately 70,000 volumes, besides much unbound or paper-bound material, pamphlets, periodicals and newspapers. The library contains also some important special collections of books, amounting to several thousand volumes, not yet catalogued. Much of the constantly increasing pamphlet and periodical material, even though it is not yet comprehended in the general catalogue, is made promptly available by means of check lists, indexes, bibliographies and other library helps. Files of important periodicals make readily accessible to readers the latest contributions to the sum of human knowledge by contemporary leaders in many fields of thought and investigation. Works dealing with the sciences related to the processes and problems of agriculture are in greatest abundance, but literature, history and sociology are also well represented in our collections of books. The reading room is well supplied with encyclopedias and other general reference books, and with current numbers of an attractive list of popular and technical magazines and periodicals.

The greater part of the library material has been recently reclassified and recatalogued in accordance with a standard system, and is thereby rendered at all times directly accessible to teachers and students as well as library workers. From time to time informal lectures on the use of the library will be given to groups of students. By seminar and laboratory methods, individual students will be taught to appreciate books as essential sources of information and culture, and will be instructed in the use of the various devices common in libraries for finding what the library contains. All members of the college community have the privilege of free access to the book stacks for reference purposes, and books not specially reserved may be loaned for extra-library use for a period of two weeks.

The library is open from 8 a.m. to 9.30 p.m. on week days, and from 9 a.m. to 1.30 p.m. on Sundays while college is in session. Shorter hours prevail during vacation.

The Graduate School.

Kenyon L. Butterfield, A.M., LL.D., President of the College.

Charles E. Marshall, Ph.D., Director of the Graduate School and Professor of Microbiology.

Graduate Staff, 1923–24.

President Butterfield, Dean Lewis, Director Marshall, Professors Anderson, Beaumont, Cance, Chamberlain, Clark, Crampton, Fernald, Graham, Itano, Lindsey, Osmun, Peters, Phelan, Sears, Shaw, Thayer, Torrey, Waugh, Welles; Mr. Watts, Secretary.

This college has provided study of a graduate nature for many years. The need for such training became real when agriculture was recognized as an aggregate of the many sciences involved and the many practices employed. The obsolete notion that agriculture is only farming has been replaced by the notion that farming, as such, is only one element in agriculture. The ramifications and divisions of agriculture are many; most of these call for advanced study and training to meet the exigencies of the times. No apology is, therefore, required for an attempt to fathom the scientific, economic and social intricacies of such a fundamental phase of human effort as agriculture. The value of such an undertaking is, or should be, patent to every intelligent mind familiar with the situation.

Graduate work has been available to students since 1893. At that time it was possible to qualify for the degree of master of science; later, in 1898, for the degree of doctor of philosophy; in 1913, for the professional degrees of master of agriculture and doctor of agriculture; in 1916, for the specific professional degree of master of landscape architecture.

To make the graduate work more effective and distinctive in agriculture, the graduate school was established in 1908. It has become the operating agency for the purpose of fitting graduates of this and other institutions for teaching in colleges, high schools and other public schools; for positions as government, State and experiment station specialists in farm management, dairying, live stock husbandry, poultry science, agronomy, landscape gardening, pomology, vegetable gardening and floriculture; for positions as bacteriologists, botanists, chemists, entomologists; for economists and social workers; and for numerous other positions requiring a great amount of scientific and professional agricultural knowledge, training and experience.

ORGANIZATION.

The school is based upon the department as the unit, and the apprenticeship system as the most effective means of instruction. This gives to the student individuality in treatment and an intimacy with actual conditions of work and operations. The student is assigned to an advisory committee, composed of the instructor in charge of his major subject as chairman, and instructors in charge of his minor subjects as members, which directs his graduate studies. The chairmen of all these committees together constitute the graduate staff, which controls the policy of the graduate school.

ADMISSION.

Admission to the graduate school will be granted: —

1. To graduates of the Massachusetts Agricultural College.
2. To graduates of other institutions of good standing who have received a bachelor's degree substantially equivalent to that conferred by this college.

In case an applicant presents his diploma from an institution of good standing, but has not, as an undergraduate, taken as much of the subject he selects for his major as is required of undergraduates at the Massachusetts Agricultural College, he will be required to make up such parts of the undergraduate work in that subject as the instructor in charge may consider necessary. He shall do this without credit toward his advanced degree.

Admission to the graduate school does not necessarily admit to candidacy for an advanced degree, — students holding a bachelor's degree being in some cases permitted to take graduate work without becoming candidates for higher degrees.

Applications for membership in the graduate school should be presented to the director of the school. Full statements of the applicant's previous training, of the graduate work desired, and of the amount and kind of work already done by him as an undergraduate should be submitted, together with a statement whether the applicant desires to work for a degree.

Registration is required of all students taking graduate courses, the first registration being permitted only after the student has received an authorization card from the director.

NATURE, METHODS AND REQUIREMENTS OF GRADUATE WORK.

Graduate work differs from undergraduate work in its purposes and methods. The primary aims of the instructor are emphasized in an attempt to have the student adjust himself and place himself in his environment; develop the rule of self-direction and self-instruction; acquire the power of accurate reasoning; gain proficiency and skill in his selected field of study or practice; and obtain an appreciative and discriminative insight into experimentation and original research. Methods are not devised, therefore, for attractiveness, entertainment and superficial reviews, but for the creation of initiative and profound thought, thorough acquaintance with detail, independent advance and industrious habits. Careful readings, lectures, conferences, surveys, laboratory exercises and field work are some of the agencies utilized.

All members of the graduate school are required to attend the course of lectures designed to supplement the technical work of all graduate studies. These lectures will be given once each week, and the students will be held responsible for the work.

Candidates for the degree of doctor of philosophy are required to prosecute three subjects, one of which shall be designated as the major and the others as minors. No two of these subjects may be taken in the same department. An original thesis shall be considered a part of the major subject.

Candidates for the degree of doctor of agriculture are required to select a major and such other subjects as will develop the major in its greatest intensity and comprehensiveness. Successful experience is also requisite, together with a thesis which represents a masterly survey or intimate study through accurate application of some phase of the major subject.

Candidates for the degree of master of science are required to prosecute two subjects, one of which shall be designated as a major and the other as a minor. These subjects may not be selected in the same department. An original thesis is considered a part of the major subject.

Candidates for the degree of master of agriculture are allowed greater privileges in the selection of subjects, but will be required to select a major and such other supporting lines of study as will be necessary to equip the individual professionally.

Candidates for the degree of master of landscape architecture will be expected to conform to the established courses of the department, and to the requirements of the department in the preparation of a thesis, as well as in actual experience outside the college.

Candidates for membership in the graduate school who do not desire to work for a degree may, with the approval of the director of the school, take more than one subject in the same department, or pursue work in several departments, if their preparation will permit. A statement of the subjects chosen must in each case be submitted to the director of the graduate school for approval. The chosen subjects must bear an appropriate relation to each other.

A working knowledge of French and German is essential to successful graduate work, and students not having this will find it necessary to acquire it as soon as possible after entering.

The graduate staff reserves the privilege of recommending and allowing courses in other institutions as a part of residence instruction. Such supervision will be exercised and credit granted as are essential to the highest standards of efficiency.

THESES.

A thesis is required of each candidate for an advanced degree. It must be on a topic belonging to the candidate's major subject; must show that its writer possesses the ability to carry on constructive study; must be an actual contribution to knowledge; and possess real merit.

The thesis in its final form must be submitted to the director by May 15 of the year in which the student is to present himself for the advanced degree, and before he may take the required examination. Three complete copies are required. One of the copies is to be retained as an official copy by the director, one is to be deposited in the college library, and the third is to be retained by the department in which the thesis was prepared. The candidate for the doctor's degree must be prepared to defend at the oral examination the views presented in his thesis.

FINAL EXAMINATIONS.

For the degree of doctor of philosophy or doctor of agriculture, final examinations on the minors taken are given upon the completion of the subjects. In the major subject a written examination, if successfully passed, is followed by an oral examination in the presence of the faculty of the school.

For the degree of master of science, master of agriculture or master of landscape architecture, a final examination upon the minor taken is given upon the completion of each course, and in the major a final examination, which may be either written or oral, or both, is given over all the work by the department concerned.

DEGREES CONFERRED.

The degrees of doctor of philosophy and doctor of agriculture are conferred upon graduate students who have met the following requirements: —

1. The devotion of at least three years[1] to the prosecution of three subjects of study and research in residence at the college.

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[1] All time statements refer to minimum time.

2. The earning of not less than one hundred credits in the chief or major subject, and of not less than twenty-five credits in each of two minor subjects.

3. The preparation of a thesis, in the major subject, constituting an actual contribution to knowledge and accompanied by drawings if necessary. For the degree of doctor of agriculture the thesis may be modified to meet professional requirements.

4. The passing of final examinations, in both the major and minor subjects, to the satisfaction of the instructors in charge.

5. A public oral examination.

6. The payment of all fees and college expenses required.

The fee for the degree of master of science, master of agriculture, or master of landscape architecture is $10, and for the degree of doctor of philosophy or doctor of agriculture, $25.

The degrees of master of science, master of agriculture and master of landscape architecture are conferred upon graduate students who have met the following requirements: —

1. The devotion of at least one year and a half to the prosecution of study in two subjects of study and research, not less than one full college year of which must be in residence. In the case of a master of landscape architecture the student must follow the prescribed course of study.

2. The earning of not less than fifty credits in the chief or major subject, and of not less than twenty-five credits in the minor subject. Students pursuing the course in landscape architecture will devote all of their time to the established course, and meet the conditions of one year of experience outside the college.

3. The preparation of a thesis in the major subject, constituting an actual contribution to knowledge, and accompanied by drawings if necessary.

4. The passing of final examinations, in both major and minor subjects, to the satisfaction of the professors in charge.

5. The payment of all fees and college expenses required.

COURSES OFFERED.

Courses available as major subjects for the degree of doctor of philosophy: —

Agricultural Economics.
Botany.
Chemistry.
Entomology.
Horticulture.
Microbiology.
Rural Sociology.

Courses available as major subjects for the degree of master of science: —

Agricultural Economics.
Agricultural Education.
Agriculture.
Agronomy.
Animal Husbandry.
Botany.
Chemistry.
Entomology.
Horticulture.
Mathematics and Physics.
Microbiology.
Poultry Science.
Rural Sociology.
Veterinary Science.

Courses available as major subjects for the degree of master of agriculture: —

Agronomy.
Animal Husbandry.
Poultry Science.

The course in Landscape Architecture leads to the degree of master of landscape architecture.

Courses available as minor subjects: —

Agricultural Economics.
Agricultural Education.
Agriculture.
Agronomy.
Animal Husbandry.
Animal Pathology.
Botany.
Chemistry.
Entomology.
Horticulture.
Landscape Architecture.
Mathematics and Physics.
Microbiology.
Poultry Science.
Rural Sociology.
Zoology.

GENERAL OUTLINE OF COURSES FOR ADVANCED DEGREES.

Agricultural Economics.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Candidates must have had the following courses or their equivalents: Economics and Sociology 51, Agricultural Economics 26 and 50.

Required Work. — Candidates must take the following courses: Agricultural Economics 51, 52, 53 and 79. These courses, specially arranged for graduates, may be taken as Courses 120, 170, 155 and 180 for graduate credit. In addition, candidates must take Courses 110, 111, 130, 165 and 175 in Agricultural Economics; Rural Sociology 27 and 50, or equivalent courses; and Economics and Sociology 50 and 77, or equivalent courses.

Each candidate will be required to have a working knowledge of the general field of economics, the history of agricultural economics, the theory of agricultural economics, the problems of agricultural production, land tenure, land problems, agricultural commerce, agricultural co-operation, agricultural credit, statistics of agriculture, and prices, markets and marketing.

For the Degree of Master of Science.

Prerequisite Work. — The same as for the degree of doctor of philosophy.

Required Work. — The same as for the degree of doctor of philosophy, except that there is no language requirement.

Graduate Courses Offered.

110. Theory of Agricultural Economics. — Readings in French, German and English on economics of agriculture. Alternate years, odd, 200 hours. Credits, 3.
Professor Cance.

111. Current Economic Problems and Literature. — Department seminar throughout the year. Credit, 1 each term.

120. Historical and Comparative Agriculture. — General survey. May be taken in connection with Course 51. Spring term, yearly. Credits, 3.
Assistant Professor Sawtelle.

121–122. History of American Agriculture. — Special studies in the history of agricultural institutions, practices or relations. Fall Term, even years. Credits, 5.
Assistant Professor Jefferson.

130. Problems of Agricultural Production. — The relation of the farmer to the food supply. May be taken in connection with Course 77. Fall term, yearly. Credits, 5.
Professor Cance.

140. Land Tenure and the Acquisition of Farm Land. — Readings, discussion, original exercises. Alternate years, even. Credits, 3–5.
Professor Cance.

145. Farm Labor. — Reading and investigation. Credits, 3.
Professor Cance.

150. Agricultural Commerce, Industry and Trade. — A study of trade movements and commercial activities relating to agricultural products. Fall term, alternate years, odd. Credits, 3–5.
Assistant Professor Jefferson.

155. The Agricultural Market. — A study of the forces, methods and institutions of the market for agricultural products. Spring term, yearly. Credits, 5.
Professor Cance.

156. Specific Problems in Marketing Farm Products. — Reports and discussions. Alternate years, odd. Credits, 3.
Professor Cance.

160. Agricultural Prices. — Winter term, yearly. Credits, 3.
Assistant Professor Sawtelle.

161. Agricultural Prices. — Spring term, yearly. Credits, 3.
Assistant Professor Sawtelle.

165. Transportation of Agricultural Products. — Elementary discussion and report. Winter term, yearly. Credits, 5.
Professor Cance.

166. Specific Transportation Problems. — Original study, reading and report on certain transportation problems related to agriculture. Alternate years, odd.
Credits, 3–5.
Assistant Professor Sawtelle.

170. Co-operation in Agriculture. — Elementary problems and discussion. May be taken in connection with Course 50. Winter term, yearly. Credits, 5.
Professor Cance.

171–172. Special Problems in Co-operation for Economic Purposes. — Study, original investigation and discussion. Every third year, beginning 1922. Credits, 3–5.
Professor Cance.

175. Agricultural Credit. — Readings and reports in addition to class lectures on agricultural credit. Taken in connection with Course 78. Spring term, yearly.
Credits, 3–5.
Assistant Professor Sawtelle.

180. Elementary Principles of Statistics. — Chiefly related to agriculture. Lectures, laboratory studies and original work. Taken in connection with Course 79. Fall term, yearly. Credits, 5.
Assistant Professor Sawtelle.

181. Specific Problems in Statistics of Agriculture. — Alternate years, even.
Credits, 3–5.
Assistant Professor Sawtelle.

185. Rural Law. — Corresponds to Course 78. Spring term, yearly. Credits, 5.
Mr. Smart.

186. Studies in Agricultural Legislation. Credits, 3–5.
The Department.

190–195. Investigation of Various Problems related to Agricultural Economics. — Credit given on basis of time spent and reports submitted.

200. Thesis. — Research work in agricultural economics will be developed by four principal methods, namely, historical, statistical, accounting and general field investigation. In all instances mastery of research methods includes facility in investigation, tabulation and interpretation of results.

Agricultural Education.

Major Requirements.

For the Degree of Master of Science.

Prerequisite Work. — A minimum of 25 undergraduate credits distributed among the following lines of study: philosophy, psychology, history of education, principles and methods of teaching, school organization and administration. Graduates of other than agricultural colleges who wish to take their major work in some phase of rural education will be required to present evidence of a knowledge of rural life and rural industries both scientific and practical. This may involve the study of some undergraduate courses in agriculture or horticulture without graduate credit.

Required Work. — In addition to the regular prescribed work at least a half year of experience in teaching or supervision is required before the candidate is recommended for a degree.

Graduate Courses Offered.

100. History of Agricultural Education. Credits, 1–10.
Professor Welles.

105. Principles and Methods of Teaching Agriculture and Agricultural Science. Credits, 1–20.
Professor Welles.

110. Rural Education: its Organization and Administration. Credits, 1–20.
Professor Welles.

115. Supervision and Administration of Agricultural Education. Credits, 1–5.
Professor Welles.

120. Theory of Vocational Education. Credits, 1–10.
Professor Welles.

125. Preparation of Teachers of Agriculture. Credits, 1–10.
Professor Welles.

130. General Educational Theory and Practice. Credits, 1–15.
Professor Welles.

135. Educational Literature. Credits, 1–10.
Professor Welles.

140. Educational Research. Credits, 1–10.
Professor Welles.

200. Thesis. Credits, 25.
Professor Welles.

Minor Requirements.

Minor work is offered in this department for the degrees of doctor of philosophy and master of science. Candidates must have had the equivalent of 15 undergraduate credits in agricultural education, 5 of which must have been in the history of education.

Agronomy.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Candidates must have had undergraduate courses 25 and 27 as described in this catalogue, and should have had thorough training in the elements of the natural sciences.

Required Work. — Studies will be assigned from the courses listed below. Thesis problems may be chosen in the subject matter of soils, fertilizers or field crops.

For the Degree of Master of Science.

Prerequisite Work. — As above.

Required Work. — Assigned work will be selected from the courses listed below.

Graduate Courses Offered.

151. Field Crop Production. — (*a*) Varieties. Classification; adaptation to climatic and soil conditions, etc.

(*b*) Distribution as affected by natural and economic conditions.

(*c*) Cultural methods. Early and late planting of the potato seed crop, of silage corn; spacing of plants; keeping qualities as affected by time and methods of harvesting; tillage and moisture control, etc.

(*d*) Storage of cereals, roots and tubers as affected by aeration, temperature, humidity, previous treatment, etc. Credits, 1–25.

175. Soil Technology. — Soil Physics. Textural relationships of soil classes; absorption phenomena; physical properties in relation to mineralogical and chemical properties; soil structure; moisture relationships; the colloidal conditions of soils, etc. Credits, 1–25.

177. Soil Fertility. — (*a*) Soil Chemistry. Nitrogen fertilization, including commercial supply and gain or loss under different systems of soil management; absorption of potash and phosphoric acid; sulfur fertilization; soil acidity, etc.

(*b*) Soil Biology. Fixation of nitrogen by symbiotic and nonsymbiotic organisms; changes of green and animal manures in the soil; ammonification and nitrification; care and preservation of manures; humus in relation to soil fertility, etc.
Credits, 1–25.

178. Crop Improvement. — Involves the application of the principles of plant breeding to special crops. Credits, 1–25.

200. Thesis. Credits, 15–25.

Minor Requirements.

Prerequisites are as stated above for major work. In addition, studies suited to the needs of the candidate will be selected from the above courses.

Animal Husbandry.

Major Requirements.

For the Degree of Master of Science or Master of Agriculture.

Prerequisite Work. — Candidate must have had the following courses, or their equivalents, before he can enter graduate work in this department: Animal Husbandry 25, 26, 50, 51, 52, 53, 75 and 78. He should also be able to show evidence of experience in practical animal husbandry.

Required Work. — At least 50 credits must be earned from the following list of courses offered by the department.

Graduate Courses Offered.

100. Historical Studies of Breed Development. Credits, 5–20.

110. Animal Nutrition. Credits, 5–20.

120. Problems in Animal Feeding. Credits, 5–20.

130. Animal Genetics. Credits, 5–20.

140. Problems in Animal Breeding. Credits, 5–20.

200. Thesis. Credits, 15–25.

Minor Requirements.

Minor work in animal husbandry may include undergraduate Courses 50, 51, 53, 81 or 82, and such other work in reading and compilation of material as the instructor may outline. Written examinations will be conducted at the completion of each term's work.

Animal Pathology.

Minor Requirements.

Minor work in animal pathology for the degrees of doctor of philosophy and master of science consists of an especially planned course for graduate students. This is not an undergraduate course, but is arranged to meet the needs of graduate students who have not pursued a course in general pathology. It will continue throughout the year and include reviews in gross and microscopic anatomy, physiological, bacteriological, serological, biochemical and morbid anatomical phases of pathology. Written examinations will be given at the end of each term.

100. General Pathology. — As described above, fall term. Credits, 5.

120. General Pathology. — Continuation of 100, winter term. Credits, 5.

140. General Pathology. — Continuation of 120, spring term. Credits, 5.

160. Biochemical Phases of Pathology. — Second year, fall term. Credits, 5.

180. Pathological Histology. — Second year, winter term. Credits, 5.

Professor Gage.

Botany.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — The equivalent of certain undergraduate courses, determined by the department in the case of each student, is prerequisite.

Required Work. — Candidates will be required to take Courses 100 through 107, and 180, 190, and 200. Courses 150 through 155 may be taken for graduate credit in certain cases. The maximum number of major credits which may be earned in this way is thirty-two.

For the Degree of Master of Science.

Prerequisite Work. — The requirements are the same as for the degree of doctor of philosophy.

Required Work. — Candidates will take Courses 100 and 101 and all courses from 102 through 107 which are given during their term of residence, also 180, 190 and 200. In certain cases Courses 150 through 155 may be taken, but not more than 20 credits may be earned in this way.

Graduate Courses Offered.

Courses 100 through 106 are lecture courses. They are given in rotation, except Courses 100 and 101, which come every year.

100. Plant Physiology. — The lectures will consider, under the nutrition of the plant: its chemical structure, absorption of various nutrient substances and their changes in the plant, assimilation and dissimilation of carbon and nitrogen by autotrophic and heterotrophic plants; under changes in the form of plants; growth and form under constant external factors, the influence of variable external and inner factors on growth, form and development; and under plant movements; the various tropisms, nutations, etc. Supplemental demonstrations, laboratory work and readings in the standard texts and journals. One lecture a week for 36 weeks. Credits, 3.

101. Plant Pathology. — A general consideration of the history, nature and causes of plant disease; parasitism, predisposition, immunity, degeneration, natural and artificial infection, dissemination, epidemics, biologic strains, monstrosities and malformations, proliferation, prevention and control, economics of plant diseases. One lecture a week for 36 weeks. Credits, 3.

102. Plant Inheritance. — This course is planned to give the student a comprehensive understanding of the principles and facts of plant inheritance. A study is made of plant variations, Mendel's law of heredity, the physical basis of heredity as established by chromosome behavior, pure lines, mutations, species and graft hybrids, etc. One lecture a week for 12 weeks. Credit, 1.

103. Biologic Relations. — Consideration of certain phases of the morphological and physiological adaptations of plants with regard to insect visit; the rôle of thorns, hairs, tendrils, glands, etc. Various experiments are made to test out experimentally some of the existing theories concerning biologic adaptations. One lecture a week for 12 weeks. Credit, 1.

104. The Ecology of Plants. — This course deals with the water, light and temperature relations of plants, and the various adaptations in response to these

factors; the various types of plant formation; the migration of plants; the competition of plants; invasion and successions of plants under varied conditions; and the various types of alternations and zonations. One lecture a week for 12 weeks. Credit, 1.

105. Physiological Plant Pathology. — This course considers those plant diseases not due to bacterial or fungous parasites, but resulting from unfavorable physical or chemical conditions of the soil; from harmful atmospheric influences, such as too dry air, too much moisture, hail, wind, lightning, frost; from injurious gases and liquids; from lack of or too much light; from wounds. A knowledge of the normal physiology of the plant is required. Demonstrations and laboratory work will be given, together with assigned readings. One lecture a week for 12 weeks. Credit, 1.

106. History of Botany. — A historical survey of the science; lives of noted botanists; history of certain culture plants, such as wheat, corn, coffee, potato, rice, and their influence on civilization; reading. One lecture a week for 24 weeks. Credits, 2.

107. Methods in Drawing and Photographing for Thesis and Publication. — Twelve weeks. Credits, 1–3.

108. The Comparative Anatomy of Green Plants. — In the lectures an intensive study is directed to the comparative anatomy of green plants from the evolutionary standpoint. Particular emphasis is laid upon the woody forms both living and extinct. Of the latter, the department is fortunate in possessing excellent sets of micro-preparations and lantern slides. Two lectures and one laboratory period for 24 weeks. Credits, 6.

150. Systematic Mycology. — See undergraduate Courses 52–54.

151. Systematic Botany of the Higher Plants. — See undergraduate Courses 58 and 59.

152. Plant Histology. — See undergraduate Courses 55 and 56.

153. Cytology and Embryology. — See undergraduate Courses 82 and 83.

154. Plant Pathology. — See undergraduate Courses 75–77.

155. Plant Physiology. — See undergraduate Courses 78–80.

180. Seminar. — A weekly seminar for members of the department staff, graduate students and major senior students is held, at which important botanical papers are discussed. Attendance and participation are required. Credits, 3.

190. Collateral Reading. — Extensive reading of botanical literature in English, German and French, designed to give the student a broad knowledge of the science, is required of all major students. Final examinations are based in part upon this reading course. Credits, 5–10.

200. Thesis. — Each major student is required to select a problem in plant pathology or physiology (in other branches at the discretion of the department) for original investigation, and the thesis must embody a distinct contribution to knowledge. An effort will be made to assign problems having some bearing on scientific and economic agriculture. The thesis work counts for not more than 50 per cent of the total number of major credits required for either degree.

Minor Requirements.

For a minor a student may take such of the work offered by the department as seems best suited to his major course. Courses 150 and 155 are primarily undergraduate work which may be taken for minor credit toward advanced degrees. In most cases no problem will be assigned.

Professors Osmun, Anderson, Clark, Torrey and Davis.

Chemistry.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — The candidate must have taken undergraduate Courses 1 to 87, or their equivalent.

Required Work. — The candidate will be required to take all the graduate courses listed below. He may also be required to spend at least two terms or one semester at some other recognized institution, pursuing graduate study in chemistry. For the final examinations, questions will be selected from the entire field of chemistry, with special emphasis upon the lines of work covered by the research.

For the Degree of Master of Science.

Prerequisite Work. — The same as that required for the degree of doctor of philosophy.

Required Work. — The candidate will be required to take Courses 101 and 108 through 114. In addition he will pursue the requirements of one of the following thesis subjects: —

Organic and Biochemistry. — Course 200 and either 105, 106 or 107, and 3 credits for one term selected from Courses 103 (*b*) or (*f*), and 104.

Analytical and Industrial Agricultural Chemistry. — Courses 200, 103 (3 credits), and 3 credits for one term selected from Courses 102 and 104 through 107.

Physical Chemistry. — Courses 200, 104, and 3 credits for one term selected from Courses 102, 103 and 105 through 107.

Agricultural Chemistry. — Courses 200, 103 (3 credits), and 3 credits for one term selected from Courses 102 and 104 through 107.

The candidate must pass a final written and oral examination before the department upon undergraduate Courses 1 through 80, as well as upon all graduate work taken in chemistry.

Graduate Courses Offered.

101. Inorganic Preparations. — Laboratory. The preparation of chemical products from raw materials. The manufacture and testing of pure chemicals. The laboratory work is essentially synthetic in nature, and is designed to aid in acquiring a more adequate knowledge of inorganic chemistry than is to be obtained by chemical analysis alone. Ten to fifteen of the preparations given in Biltz's "Laboratory Methods of Inorganic Preparations" will be made by each student. Any term. Credits, 3.

Assistant Professor Serex.

102. Advanced Inorganic Preparations. — Laboratory. Continuation of Course 101. Any term. Credits, 3.

Assistant Professor Serex.

103. Advanced Analytical Chemistry. — Laboratory. This course may be taken in part as follows: (*a*) electrolytic analysis, 3 credits; (*b*) ultimate analysis, 3 credits;

(*c*) special analytical work to meet the needs of the individual student, 3 credits. In addition, parts of undergraduate Courses 62, 76 and 77 may be taken, as follows: (*d*) fertilizers, 3 credits; (*e*) insecticides, 3 credits; (*f*) milk and butter, 3 credits. (*a*), (*b*), (*c*) may be taken any time; (*d*), (*e*), (*f*) must be taken at the time the undergraduate course is given.

Professor Peters.

104. Advanced Physical Chemistry. — Laboratory. Measurement of the electrical conductivity of solutions; degree of ionization; ionization constants; per cent hydrolysis of aniline hydrochloride from conductivity measurements; solubility product by the conductivity method; velocity of saponification by conductivity; neutralization point by conductivity; vapor pressure determinations; critical temperature of carbon dioxide or sulphur dioxide; transport numbers; preparation and properties of colloidal solutions; transition points by dilatometric method; heat of solution of ammonium chloride and potassium nitrate; adsorption of iodine by charcoal; splitting of racemic glyceric or racemic tartaric acid into its optical components. To each student separate work will be assigned. Any term. Credits, 3.

Assistant Professor Serex.

105. Advanced Organic Preparations. — Laboratory. The preparation of compounds not included in Courses 51 and 52, such as the Kolbe synthesis of salicylic acid; benezophenone and Beckmann's rearrangement; rosaniline, malachite green, Congo red, indigo and other dyes; synthesis of fructose; Grignard reaction. Barnett, Cain & Thorpe, Gattermann, Noyes, Fischer and other laboratory guides are used. To each student separate work will be assigned. Any term. Credits, 3.

Professor Chamberlain.

106. Advanced Biochemistry. — Laboratory. The hydrolysis of proteins and isolation of the amino acids; the study of milk, blood and urine; dietary and digestion studies. References: Abderhalden, Plimmer, Salkowski, Hawk, etc. To each student separate work will be assigned. Any term. Credits, 3.

Professor Chamberlain.

107. Industrial Organic Chemistry. — Laboratory. The preparation, on a large scale, of wood alcohol, acetic acid, ethyl alcohol, benzene and cellulose products, such as mercerized cotton and artificial silk. References: Molinari, Rodgers & Aubert, Thorpe, Enzyklopädie der tech. Chemie, etc. To each student separate work will be assigned. Any term. Credits, 3.

Professor Chamberlain.

108. Theoretical Chemistry. — Lectures. The following topics are considered: the compressibility of the atoms; the structure of atoms; the electron conception of valence. First term. Alternates with Course 109. Credit, 1.

Professor Peters.

109. Analytical Chemistry. — Lectures. A general survey of methods and technique covering processes commonly carried out in the laboratory. Gooch's "Quantitative Analysis" is used as a text. First term. Alternates with Course 108. Credit, 1.

Professor Peters.

110. Organic Chemistry. — Lectures. Some of the following topics will be considered both theoretically and industrially: alkaloids, synthetic dyes, essential oils, terpenes, rubber, etc.; the study of methods for carrying out general reactions;

isomerism, tautomerism, condensation, etc. References: Cain & Thorpe, Cohen, chemical monographs, Lassar-Cohn, Heinrichs, Molinari. Second term. Alternates with Course 111. Credit, 1.
Professor Chamberlain.

111. Biochemistry. — Lectures. Some of the following topics will be considered both chemically and physiologically: fats, cholesterol, lecithin, carbohydrates, amino acids, proteins, urea, uric acid, purine bases, enzymes, fermentation, animal food and nutrition, photosynthesis. References: Monographs on biochemistry, Abderhalden, Plimmer, Haas & Hill, Lewkowitsch, Fischer, Euler, Mathews, Czapek. Second term. Alternates with Course 110. Credit, 1.
Professor Chamberlain.

112. Theoretical and Physical Chemistry. — Lectures. The relation between the constitution and properties of compounds; mutarotation; steric hindrances; stereoisomerism of other elements than carbon; molecular association; similarity between the compounds of silicon and carbon. Third term. Alternates with Course 113. Credit, 1.
Assistant Professor Serex.

113. Theoretical and Physical Chemistry. — Lectures. Radioactivity; the application of physical chemistry to industrial chemistry. Third term. Alternates with Course 112. Credit, 1.
Assistant Professor Serex.

114. Seminar. — Conferences, reports or lectures. Three terms, twice a month. Credit, $\frac{1}{2}$.
Professor Lindsey.

200. Thesis. — Research, and, in the case of a degree, the preparation of an acceptable thesis in agricultural, analytical, organic or physical chemistry, under the direction of the professor in charge of the work, provided that a candidate for the degree of doctor of philosophy shall have had the equivalent of Courses 51, 52, 65 and 86. Credit determined by work done.

Minor Requirements.

Work may be selected from any of the undergraduate Courses 27 and 51 to 80, or any of the graduate courses for which the student is prepared provided that any candidate for the degree of doctor of philosophy, who is taking chemistry as a minor, shall have had the equivalent of Courses 5, 52, 65 and 86. In addition, the candidate may be required to pass a final written and oral examination before the department upon his entire minor work.

Entomology.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Students must have had all the undergraduate courses given at this college or their equivalent. Opportunities to make up any deficiencies will be available while the graduate work is being carried on.

Required Work. — The graduate courses consist of lectures on all, and laboratory work on a part, of the subjects given below, together with advanced readings, seminar work and original research.

For the Degree of Master of Science.

Prerequisite Work. — The same as for the degree of doctor of philosophy.

Required Work. — A major course for the master of science degree will be about half of the courses listed below.

Graduate Courses Offered.

100. Morphology. — 1. Embryonic development of insects and polyembryony.
2. Metamorphosis and its interpretations.
3. Advanced external and internal anatomy.
4. Insect histology.
5. Ancestry and development of insects, including fossil insects.
6. Hermaphrodites in insects.
7. Hybrids.
8. Parthenogenesis, pedogenesis and heterogeny.
9. Chemistry and physics of insect colors.
10. Color patterns, their significance and value.
11. Luminosity.
12. Deformities.
13. Variation in insects.

120. Ecology. — 1. Dimorphism and polymorphism.
2. Mimicry, including concealment, protective devices and warning coloration.
3. Architecture of insect structures.
4. Relation of insects to plant fertilization and its importance.
5. Insect products of value to man.
6. Geographical distribution and methods of distribution of insects, with a consideration of life zones, barriers, etc.
7. Insect migrations.
8. Insect behavior and experimental entomology.
9. Enemies of insects.

140. Economic Entomology. — 1. Control methods.
2. Insect photography and methods of preparing illustrations.
3. Field work and life history investigations with methods for keeping records.
4. Legislation about insects.
5. Studies of insecticides and their application.

160. Systematic Entomology. — 1. History of entomology and of classifications.
2. Lives and works of prominent entomologists.
3. Abundance of insects.
4. Important collections, public and private; their location and their value.
5. Types of insects; their significance, importance and location.
6. Rules of nomenclature and how they are used.
7. Methods for collecting, preparing, preserving and shipping insects.

180. Seminar. — Readings and reports on the current literature of entomology; monthly meetings.

190. Collateral Readings. — The best articles on the various topics in entomology are assigned for collateral readings, and are included in the final examinations.

200. Thesis. — Original research on one or several topics in morphology, ecology, economic and systematic entomology. This is expected to require from one-half to three-quarters of the total working time of the student.

MINOR REQUIREMENTS.

Minor courses will cover such parts of the work outlined above as will be most likely to prove useful in connection with the majors taken by the students, or in their future work. It is not required that such men shall have had all the undergraduate work in entomology given at this college, their credit for a minor beginning where their own undergraduate training in the subject ended.

Horticulture.

Graduate work is offered in various lines of horticulture. For the most part this is divided into the different departments which constitute the college Division of Horticulture, as follows: pomology, floriculture, landscape gardening, forestry and market gardening. For work in these lines application should be made direct to the heads of the several departments.

Besides this work, however, opportunity is offered for graduate study in general horticulture, including topics from the several organized departments mentioned, and also questions relating to plant breeding, general evolution, propagation, manufacture of horticultural products, etc. This general work is under the direction of Professor Waugh, head of the Division of Horticulture.

Landscape Architecture.

MAJOR REQUIREMENTS.

For the Degree of Master of Landscape Architecture.

PREREQUISITE WORK. — The undergraduate courses in the college known as Landscape Gardening 50, 51 and 52, Drawing 25, 26 and 27, Horticulture 27, 50 and 51, and Mathematics 26 and 27 will be considered prerequisite to graduate work, and any student who has not passed these courses, or their equivalent, will be required to make up such work without graduate credit.

REQUIRED WORK. — Each student before he may receive the master's degree with a major in this department must convince his instructors that he has a genuine aptitude for some branch of landscape gardening, either in design, construction or management.

The minimum period of graduate study will be one and one-half years. At least one year of this time must be spent in residence at the college. One year must also be spent in practice outside the college. The work done outside the college may be prescribed by the department, and must be fully reported to the department in writing. It is essential, further, that the candidate secure the written approval of his employers outside the college. The department may, at its discretion, require a longer period of study at the college or a longer apprenticeship outside the college.

Every student before receiving his master's degree in landscape architecture, must have given some thorough and fruitful study to each of the following five departments. As far as possible these studies must be of a practical nature, *i.e.*, they must be made upon actual projects in progress of development.

1. *Theory.* — The principles of esthetics as applied to landscape architecture.
2. *Design.* — The principles of pure design and their application in landscape and garden planning.
3. *Construction.* — The practical methods of carrying out landscape plans, laying out, equipment, organization of working force, time and cost keeping, etc.
4. *Maintenance.* — Methods, organization, cost.
5. *Practice.* — Office work, drafting, estimating, reporting, charges, accounting.

While great freedom is allowed to graduate students in their plans of work, a certain portion of time will always be given to systematic courses of instruction. Courses

known as Landscape Gardening 175, 176, 177, 178, 179, 180, 181 and 182 are required, and may or may not be accepted for graduate credit, at the discretion of the department.

GRADUATE COURSES OFFERED.

175. THEORY OF LANDSCAPE ART. — Same as Landscape Gardening 75. First term. Credits, 3.
Professor WAUGH.

176. CIVIC ART. — Same as Landscape Gardening 76. Second term. Credits, 4.
Professor WAUGH.

177. COUNTRY PLANNING. — Same as Landscape Gardening 77. Third term. Credits, 4.
Professor WAUGH.

178. ARCHITECTURE. — Same as Landscape Gardening 78. Third term. Given in alternate years. Credits, 3.
Assistant Professor HARRISON.

179. CONSTRUCTION. — Same as Landscape Gardening 79. Third term. Given in alternate years. Credits, 3.
Assistant Professor HARRISON.

180. THEORY OF DESIGN. — Same as Landscape Gardening 80. First term. Credits, 4.
Professor WAUGH.

181. ESTATE DESIGN. — Same as Landscape Gardening 81. Second term. Credits, 4.
Assistant Professor HARRISON.

182. PARK DESIGN. — Same as Landscape Gardening 82. Third term. Credits, 4.
Assistant Professor Harrison.

190. THEORY. — Special studies. Credits, 2–10.
The DEPARTMENT.

191. DESIGN. — Individual problems by arrangement. Credits, 2–10.
The DEPARTMENT.

192. CONSTRUCTION. — Individual problems by arrangement. Credits, 2–10.
The DEPARTMENT.

193. MAINTENANCE. — Special studies, experimental work or assigned problems. Credits, 2–10.
The DEPARTMENT.

194. PRACTICE. — Professional field work under supervision. By arrangement. Credits, 2–10.
The DEPARTMENT.

195. SEMINAR. Credits, 1–5.
Professor WAUGH.

200. Thesis. — Each student before receiving the master's degree with a major in landscape architecture must present a satisfactory thesis or complete project. A thesis will consist of a careful original study of some problem in landscape architecture, presented in typewritten form with any necessary illustrations, such as photographs, diagrams, drawings, etc. A project will consist of a completed set of studies of some suitable landscape-gardening problem, such as the design of a park, a real estate subdivision, an extensive playground. Such a project will usually consist of —

(*a*) Original surveys, including topography.
(*b*) Block plans, showing original design.
(*c*) A rendered plan or plans of the main features.
(*d*) Detailed working drawings.
(*e*) Estimates of cost.
(*f*) Complete report and letter of transmittal.

Credits, 5–20.

Minor Requirements.

Any student electing a minor in landscape architecture will be directed to take such courses from the regular catalogue list as may seem most suitable to him. Under ordinary circumstances no other work will be given to students electing minors. In special cases, however, individual problems will be assigned and individual instruction given. These exceptions will be made in cases where, by so doing, it is possible to give the student material assistance in the plan of his major work.

Microbiology.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Candidate must have had Courses 50, 51, 52, 80, 81, 82 and 83, or their equivalents, before he can enter upon graduate work.

Required Work. — Studies will be selected from the courses offered below. It will be the purpose of the department to distribute such studies among the courses offered in a manner to gain the greatest efficiency and a comprehensive knowledge of the entire field. The work will be conducted by prescribed readings, critical written reviews, conferences, lectures and laboratory exercises.

For the Degree of Master of Science.

Prerequisite Work. — The same as for the degree of doctor of philosophy.

Required Work. — Courses of a basic and applied character selected from the courses offered below which will prepare the student for effective effort.

Graduate Courses Offered.

100. History of Microbiology. Credits, 5–10.

110. Cytological and Morphological Studies and Corresponding Technique. Credits, 5–10.

120. Studies in Technique and Methods. Credits, 5–20.

130. Physiological Studies. Credits, 5–20.

135. Industrial Fermentations. Credits, 5–10.

140. Agricultural Microbiology — General Survey. Credits, 5–20.

141. Microbial Studies in Agriculture. Credits, 5–10.

150. Soil Microbiology. Credits, 5–20.

160. Dairy Microbiology. Credits, 5–20.

170. Food Microbiology. Credits, 5–20.

180. Hygienic Microbiology. Credits, 5–20.

181. Special Sanitary or Hygienic Studies. Credits, 5–10.

190. Lectures and Study of Literature. Credit, 1 each term.

200. Thesis. — Some microbiological problem related to agriculture or food. Distributed as may be most beneficial for research work. Time and credit by arrangement. Credits, 15–50.

Minor Requirements.

Minor work in microbiology may consist of undergraduate Courses 50, 51, 52, and other courses designed to support the major work, from among the courses offered above. The candidate will also be required to pursue graduate Course 190, or follow a course of reading and conferences through three terms. In case the candidate has had some of these courses, he will be required to take more advanced substitute courses.

Pomology.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Candidates must have had the equivalent of the courses required for graduation from this college; also sufficient practical experience to enable them to understand and appreciate the problems of orchard practice.

Required Work. — The work outlined below will be required of all candidates.

For the Degree of Master of Science.

Prerequisite Work. — The same as for the degree of doctor of philosophy.

Required Work. — One-half of the work outlined below, selected to meet the needs of the individual student, will be required.

Graduate Courses Offered.

101. Experimental Methods. Credits, 15–20.

A critical study of the methods of research that have been used or may be helpful in pomological work. The following topics will be considered from the point of view of the investigator in pomology.

1. Statistical methods.
2. Measures of growth and yield.
3. The conduct of plot experiments.
4. Methods of soil study in their relation to pomological research.
5. Chemical methods of pomological research.
6. Methods of physiology applicable to fruit plants.
7. Microchemistry.

102. Pomological Research. Credits, 15–20.
A critical survey of past and current research work in pomology. Semi-weekly meetings for reports and discussions will be held. The following topics will be taken up.
1. Orchard soil management.
2. Soil fertility and fertilizers.
3. Physiology of pruning tree fruits and bush and vine fruits.
4. Fruit bud differentiation.
5. Sterility and fertility.
6. Genetics of fruit plants.
7. Climatology and winter injury.
8. Advanced morphology.
9. Spraying machinery and equipment.
10. Special practices.

103. Advanced Laboratory Work. Credits, 5–12.
Each student will be required to become familiar with the research work of the department and to have a share in it. So far as this has value as graduate work he will receive credit.

104. History of Pomology. Credits, 2–5.
The men, institutions and other influences that have contributed to the development of the science and art of pomology.

105. Horticultural Taxonomy. Credits, 2–3.
A study of the history and development of plant classification with special reference to horticultural plants. A study of modern classification carries with it an expression of opinion as to the evolution of cultivated plants.

106. Advanced Systematic Pomology. Credits, 6–10.
The principles of systematic pomology including a study of nut and subtropical fruits not usually dealt with in undergraduate courses.

200. Thesis. Credits, 40–50.
Each student will be required to carry out an original investigation of an assigned problem. In the planning, executing and interpreting the data of this problem he must show marked ability. The results are embodied in a thesis to be passed upon by the Department and the Graduate Staff.

Minor Requirements.

Students taking a minor in pomology will select such of the above courses as may be suited to their needs. Certain advanced undergraduate courses may also be taken for minor credit.

Poultry Science.

Major Requirements.

For the Degree of Master of Science or Master of Agriculture.

Prerequisite Work. — The postgraduate course presupposes all under-graduate work or its equivalent, together with practical experience. Without the latter, students will be unable to handle Courses 140, 150 and 160. At the discretion of the instructor in charge, graduate students may be required to pursue undergraduate courses in other departments without credit.

Required Work. — All the courses listed below. Practical poultry work may be required, but no credit will be given for such work.

Graduate Courses Offered.

101. Reading. — A review of the entire field of poultry literature, covering books, bulletins and special articles, is made, and a written report on one or more subjects required.

110. Seminar. — A critical review and a criticism of the more important experiments carried on at various stations in this and other countries; also a study of poultry conditions in foreign countries, methods of management, etc., besides a detailed study of some of the largest poultry projects in this country.

120. Anatomy (Gross and Histological), Physiology and Surgery. — This course requires a careful study of the anatomy and physiology of the fowl. Special attention is given to a study of those structures concerned with practical poultry problems. Instruction in surgical technique, adapted to fowls, may also be given.

130. Breeding. — The student will carry on such breeding experiments as time and facilities permit. He may also do work in connection with our regular experimental projects. A detailed study of the pertinent literature will be required. Animal Husbandry 5, or its equivalent, is a prerequisite.

140. Feeding. — A study of the relation of various foods and other substances to the morphology and physiology of the bird, with special reference to such subjects as egg production, feather form and structure, condition of flesh, bone, etc.

150. Brooding. — Studies will be made upon the relation between viability and rate of growth and the following topics: type of brooder, number of chicks in brood, ventilation, humidity, sanitation, exercise and weather conditions; also a comparison of natural methods with artificial methods of rearing chicks.

160. Incubation and Embryology. — A number of problems of a practical, scientific and mechanical nature relating to incubation are considered. The work in embryology is of an advanced nature, dealing with its relation to morphogenesis and heredity, and presupposes an elementary knowledge of the embryology of the chick.

170. Poultry Diseases and Sanitation. — In this course a study is made of various problems in poultry sanitation, with particular reference to methods relating to the control and eradication of disease.

200. Thesis.

Minor Requirements.

Courses 101 and 110 are designed particularly for minors.

Rural Sociology.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Candidates must present satisfactory evidence of having completed at least 10 credit hours in general sociology and 10 credit hours in general economics; or take such undergraduate courses as the department may designate to satisfy this requirement.

Required Work. — Candidates must take or pass by satisfactory examination courses offered by the department for undergraduates bearing the numbers 26, 50,

51, 52 and 75, and such courses in agricultural education and agricultural economics as may be required, not to exceed 10 credit hours in each department. Candidates will be required to select from the courses listed below as graduate courses a field for investigation and intensive study. Candidates for the doctorate must take all courses listed as graduate.

For the Degree of Master of Science.

Prerequisite Work. — The same as for the degree of doctor of philosophy.

Required Work. — Not less than 50 credit hours will be required from the courses listed below. The department will make such selection as may best meet the interest of the individual student.

Graduate Courses Offered.

177. Field Work of an Investigational Nature.

178. Rural Social Surveys.

179–181. Seminar.

182. Social Conditions of American Rural Life.

183. Social Conditions of European Rural Life.

184. Rural Institutions.

185. Rural Organization.

186. Farmers' Organizations.

187. Town and Village Rural Life.

188. Rural Health and Sanitation.

189. Rural Literature.

190. Rural Government and Law.

200. Thesis.

Veterinary Science.

Work is available in hygiene, veterinary pathology, and other special lines or divisions of the subject.

Zoölogy.

Minor Requirements.

Courses in zoölogy may be available as a minor for the degrees of doctor of philosophy and master of science. The nature of the work will necessarily vary according to circumstances, and may be intensive in a special field and correlated closely with the major work of the student, or it may be of a more general character, depending on the student's needs or previous acquaintance with general zoölogical science.

The Short Courses.

The short courses offered by the Massachusetts Agricultural College are designed to meet the needs of those, both young and old, who cannot come to the college for the regular college courses. They furnish the student with instruction in modern accepted methods, and are planned to help the farmer and the housewife.

The short courses include: —

A. The Two-year Course in Practical Agriculture.
B. The Ten Weeks' Winter School.
C. The Summer School.
D. The Vocational Poultry Course.

Requirements for Admission to Short Courses. — Students must be at least seventeen years of age, and must furnish satisfactory evidence of good moral character. References are required. There are no entrance examinations. The sole test is ability to do the prescribed work. Students enrolling for the Two-year Course in Practical Agriculture must have at least a common school education.

Expenses of Short Courses. — The expense of attending any of the short courses is approximately as follows: —

Furnished rooms in private houses (per week)	$3 to $5
Board at college dining hall (per week)	$7
Board with private families (per week)	$6.50 to $9
Registration fee (Ten Weeks' Winter School)	$5

Tuition in all the short courses is free to residents of the Commonwealth. Small laboratory fees are charged in some of the courses.

A. TWO-YEAR COURSE IN PRACTICAL AGRICULTURE.

The Two-year Course in Practical Agriculture is offered to meet the needs of students who for one reason or another cannot take the four-year college course. It is designed to provide a large amount of practical information and training in agriculture and horticulture.

It will appeal, not only to young men and women, but also to men and women of mature years and practical experience who wish to know more about the business of farming. Although the course is planned to meet the needs of those who are not graduates of high schools, the instruction is not preparatory or elementary in its nature, but is so planned that it will be of value to all. The greater amount of academic training that some of the students may possess will in a measure be offset by the fund of practical knowledge possessed by many who have completed only the elementary schools.

The course is not intended for students enrolled in high schools. Such students should finish the high school course. Students enrolled in high schools who wish to take the course should bring a statement either from the principal of the high school or from parent or guardian asking permission to be enrolled.

The Two-year Course in Practical Agriculture is arranged so as to provide specific

vocational training for the particular lines of agricultural work which the students may select. When a student enrolls he is required to state the type of farming in which he expects to engage; and to select from the following courses of study the one he wishes to pursue: —

1. General agriculture, with animal husbandry as the principal subject.
2. General agriculture, with poultry as the principal subject.
3. Dairy manufactures.
4. General horticulture.
5. Pomology.
6. Floriculture.
7. Vegetable gardening.

He then pursues a specially arranged course of preparation for that type of work. This specialization does not prevent his securing a general working knowledge of other subjects in which he may be interested.

The advantages of the college staff of specialists and the college plant with all its resources are thus made available to young men and young women who may not have had the opportunity of securing a high school education.

The first year consists of six months of study at the college. The term begins with the college fall term and closes with the winter term of the regular session. The same vacation periods are observed as in the regular four-year course.

At the close of six months of study, students are required to gain six months of farm experience. The college will assist students in finding positions and in placing them on farms where the experience gained will be of great advantage. Thus an effort will be made to place on a dairy farm the man expecting to take up dairying as his chief line of work, and a student of pomology on a fruit farm.

During the second year the student spends nine months in resident study, completing the subject pursued in the first year.

Each student is required to file with the treasurer of the college a statement, signed by the town (or city) clerk of the town (or city) from which he enrolls, stating that the parent or guardian of the student is a resident of that town.

Certificate. — All students will receive a certificate showing their standings in courses in which they were registered. Credits earned in the Two-year Course in Practical Agriculture or in any other of the short courses do not lead to the college degree. Students who possess college entrance requirements and who wish to take the regular college work should address the registrar of the college.

Tuition. — Tuition is free to residents of Massachusetts. Students who are not residents of Massachusetts are charged a tuition fee of $60 a term.

B. THE WINTER SCHOOL.

The Winter School, beginning usually about January 1 and continuing for ten weeks, was started several years ago, and has always been very popular, not only with more mature farmers and their wives, but with young men and women who control or manage farms. The courses, though short, are very practical in their nature, and are so arranged that a student may choose such subjects as will enable him to specialize along the line of work in which he is most interested. There is a wide range in the choice of subjects, making it possible for the student to take work for several winters in succession. Many college graduates enroll for the Winter School.

Scholarships. — The Jewish Agricultural and Industrial Aid Society of New York has instituted a system of free scholarships to enable the children of Jewish farmers to attend the short winter course in the States in which they reside. The stipend is sufficient to pay all the expenses of the holder for the course. Such expenses usually amount to from $100 to $150. The following courses are offered: —

Outline of the Ten Weeks' Winter School, January 2 to March 7.

Soil Fertility. Three lectures a week.
Field Crops. Two lectures and one two-hour laboratory period per week.
Types and Breeds of Livestock. Three lectures and two two-hour laboratory periods a week.
Livestock Feeding. Three lectures per week.
Animal Breeding. One lecture and one two-hour laboratory period per week.
Dairying. Five lectures and five laboratory periods per week.
Dairy Bacteriology. Two lectures and one two-hour laboratory period per week.
Animal Diseases and Stable Sanitation. Two lectures per week.
Poultry Husbandry. Five lectures and one two-hour laboratory period per week.
Fruit Growing. Three lectures and one two-hour laboratory period per week.
Market Gardening. Three lectures and two two-hour laboratory periods per week.
Floriculture. Five lectures per week.
Horticultural Manufactures. Two lectures and two laboratory periods per week.
Farm Management. Two lectures a week.
Farm Accounts. Two two-hour laboratory periods per week.
Marketing. Two lectures a week.
Agricultural Credit. Two lectures a week.
Botany. Two lectures a week.
Entomology. Three lectures per week.
Farm Structures. Two lectures and one two-hour laboratory period per week.
Farm Machinery. Two lectures and three two-hour laboratory periods a week.
Rural Sanitary Science and Hygiene. Two lectures per week.
Vocational Guidance. One lecture per week.
Foods. One lecture and two two-hour laboratory periods per week.
The Business of the Household. Three class hours per week.
Home Care of the Sick. Three class hours per week.
Principles and Methods of Vocational Agricultural Teaching. Five exercises per week.
Special Methods in Vocational Agricultural Teaching. Five exercises per week.
Professional Improvement Problems. Five periods per week.

C. THE SUMMER SCHOOL.

The summer school has been maintained by the college for a number of years. The experience of these years has been a value in arranging short, intensive, practical courses that will meet the needs of teachers, home makers and professional workers, who wish instruction in agriculture, agricultural education and home economics, and who can most conveniently come to the college during the summer. The instruction is given by the regular members of the college staff, assisted by outside lecturers. In previous years the term has been four weeks.

The nature of the work of the summer school is indicated by the following typical program: —

Agriculture and Horticulture: —
- Poultry husbandry.
- Fruit growing.
- Flower growing.
- Vegetable gardening.
- Food preservation.
- Beekeeping.

Home economics: —
- Foods and nutrition.
- Preparation and serving of meals.
- Garment making.
- Dress design and construction.
- Millinery.
- House furnishing.
- Home management.

Related subjects: —
- Insect life.
- Bird life.
- Recreation.
- Dramatic presentation.
- Design and practical arts.
- Rural sociology.
- Hygiene and sanitation.

Agricultural education: —
- Principles and methods of teaching.
- Special methods in vocational agricultural teaching.
- Professional improvement problems.
- Supervision and administration of agricultural education.
- Vocational education.

D. ONE-YEAR VOCATIONAL COURSE IN POULTRY HUSBANDRY.

Purpose. — This course is designed for graduates of the agricultural vocational schools and others who wish to prepare themselves for practical poultry keeping, and can spend only one year at college.

Scope. — The work covers seven detailed courses in poultry husbandry, as well as short-course work in fruit growing, market gardening, animal husbandry, or other subjects that will be helpful to poultry raisers. In addition to classroom and laboratory exercises each student is required to put in from twenty-five to thirty hours per week at the plant in the care and management of poultry, for the purpose of becoming proficient in the various branches of the work.

Entrance Requirements. — Applicants must be at least eighteen years of age and have a good elementary education.

Fees. — There is no tuition for residents of Massachusetts, but a laboratory fee of $5 is required for both the fall and spring terms.

Note. — The course is limited to sixteen students. The One-year Poultry Course begins in December and continues until the following December.

Due to a strong demand for the course, it was necessary to start a second class in vocational poultry at the beginning of the winter term. Thirty students were enrolled in both classes of vocational poultry.

General Information.

A. FINANCIAL AND ADMINISTRATIVE.

Student Expenses.

Tuition.[1] — Tuition is free to residents of Massachusetts. Students who are not residents of Massachusetts are charged a tuition fee of $180 a year. Students entering from Massachusetts are required to file with the president a statement signed by either town or city clerk stating that the applicant's father is a legal resident of Massachusetts.

All students entering the college for the first time as undergraduates or two-year students are charged a matriculation fee of $5, which in event of a student leaving the institution shall, if all bills due the college are paid, be remitted, or which shall upon graduation be considered as payment for the diploma.

Dormitories and Board. — The college has dormitory accommodations for about 62 men students. The rooms in the dormitories are occupied by the upper classmen, hence new students find it necessary to room in private houses. The rooms in the college dormitories are unfurnished; for the most part they are arranged in suites of three, — one study room and two bedrooms. These rooms are heated by steam and lighted by electricity; they are cared for by students occupying them. The dormitory rent for each person varies from $39 to $66 a year. The rent for furnished rooms in private houses ranges from $1 to $4 a week for each occupant. Correspondence in regard to rooms should be addressed to the dean of the college.

Board may be obtained at the college dining hall. At present, the price of board there is $7 a week.

Expenses.

The necessary college expenses are estimated as follows: —

Tuition: citizens of Massachusetts, free; others, $180 per year.

	Low.	High.
Matriculation fee, first year	$5 00	$5 00
Room in college dormitories or in private houses	39 00	110 00
Board, $7 per week	45 00	45 00
Laundry, 50 to 85 cents a week	18 00	30 00
Laboratory fees	5 00	25 00
Books, stationery and miscellaneous items	38 00	60 00
	$350 00	$475 00

Other Expenses. — Prospective students should understand that the above estimates cover expenses which may be called strictly college expenses, and that there are other financial obligations voluntarily placed upon students which they should expect to meet. Chief among these are class assessments and taxes levied for maintenance of various organizations, such as the Social Union, Athletic Association, weekly publications, etc. Such expenses vary from $15 to $30 a year. Additional financial responsibility is also assumed by students joining a fraternity or entering into other social activities of the college. Students rooming in college dormitories are obliged

[1] This statement applies to those registering as regular or two-year students.

to equip their own rooms with furniture. The college assumes no responsibility in regard to the safe keeping of student property either during the college term or vacations, except under such special arrangement as may be made with the treasurer. Besides the amount necessary for clothes and traveling, the economical student will probably spend between $400 and $500 per year.

Initial Charges.

At the opening of the college year, before students are registered in their classes, the following charges are payable at the treasurer's office: —

	Freshmen.	Sophomores.	Juniors and Seniors.
Matriculation fee	$5 00	-	-
Board (if at college dining hall) four weeks in advance	28 00	$28 00	$28 00
Assessment for support of Social Union	1 50	1 50	1 50
Laboratory fees	5 00	5 00	2 00-10 00
Room rent (if in college dormitory)	-	-	12 00-20 00
Student tax for support of athletics[1]	5 00	5 00	5 00
Student tax for support of nonathletic activities[1]	3 00	3 00	3 00

[1] While this is not essentially a college charge, the treasurer of the college acts as collector for the student activity, and all students are expected to make the payment as indicated. The subscription price of the "Collegian" is fixed by the managers; the amount of athletic tax by vote of the student body.

Laboratory Fees.

The principles observed in establishing laboratory fees are the requirement that students pay for those materials actually used which cannot be supplied by the individual, and that the laboratory fees include a charge sufficient to guard against wanton waste and breakage. Fees may be established for any course without previous announcement. At present, the fees charged are as follows: —

	Per Term.
Agronomy: —	
Course 27	$2 00
Course 50	2 50
Course 51	2 50
Course 75	2 00
Course 77	2 50
Course 78	2 50
Animal husbandry: —	
Course 25	1 50
Course 26	1 50
Course 75	1 50
Course 78	1 00
Dairying: —	
Course 50	3 00
Course 51	3 00
Course 75	3 00
Course 76	3 00
Course 77	3 00
Farm management: —	
Course 75	1 50
Course 76	1 50
Poultry husbandry: —	
Course 51	2 50
Course 52	3 00
Course 76	2 00
Course 77	2 00

	Per Term.
Rural engineering: —	
Course 25	$1 50
Course 26	1 50
Course 75	1 50
Course 78	1 50
Floriculture: —	
Course 50	2 50
Course 51	2 50
Course 52	2 50
Course 53	2 50
Course 75	2 00
Course 76	2 00
Course 77	2 50
Course 55	2 50
Forestry: —	
Course 56	2 00
Course 57	3 00
Course 58	4 00
Landscape gardening: —	
Course 50	2 50
Course 51	2 50
Course 52	2 50
Course 76	3 00
Course 77	3 00
Course 80	3 00
Course 81	3 00
Course 82	3 00
Vegetable gardening: —	
Course 50	2 00
Course 52	2 00
Course 53	2 00
Course 75	3 00
Course 76	2 00
Pomology: —	
Course 54	4 00
Course 75	4 00
Drawing: —	
Course 25	3 00
Course 26	3 00
Course 27	3 00
Botany: —	
Course 3	1 50
Course 25	1 50
Course 26	1 50
Course 50	2 00
Course 51	2 00
Course 52	2 00
Course 53	2 00
Course 54	2 00
Course 55	3 00
Course 56	3 00
Course 75	3 00
Course 76	3 00
Course 77	3 00
Course 78	3 00
Course 79	3 00
Course 80	3 00
Course 82	3 00
Course 83	3 00

	Per Term.
Entomology: —	
Course 50	$1 00
Course 51	1 00
Course 53	1 00
Course 54	1 00
Course 55	1 00
Course 75	2 00
Course 76	3 00
Course 77	3 00
Course 78	3 00
Chemistry:[1] —	
Course 1	3 00
Course 2	3 00
Course 4	3 00
Course 5	3 00
Course 25	4 00
Course 26	4 00
Course 27	5 00
Course 30	3 00
Course 51	5 00
Course 52	5 00
Course 62	5 00
Course 65	4 00
Course 76	5 00
Course 77	5 00
Course 80	4 00
Course 86	5 00
Course 91	5 00
Course 92	5 00
Course 93	5 00
Course 94	5 00
Course 95	5 00
Mathematics and engineering: —	
Course 27	1 50
Course 78	1 50
Microbiology: —	
Course 50	5 00
Course 51	5 00
Course 52	5 00
Course 75	5 00
Course 76	5 00
Course 80	5 00
Course 81	5 00
Course 82	5 00
Course 83	5 00
Physics: —	
Course 27	3 00
Course 50	3 00
Course 51	3 00
Course 52	3 00
Veterinary science: —	
Course 78	2 00
Course 79	2 00
Course 80	2 00
Course 85	2 00
Course 86	2 00
Course 87	2 00

[1] An additional deposit of $1 for Courses 1 to 6, inclusive, and $2 for Courses 25 to 95, will be required to cover individual breakage. In case the laboratory breakage does not equal the deposit, the balance will be refunded.

	Per Term.
Zoölogy: —	
Course 25	$3 00
Course 26	3 00
Course 50	3 00
Course 51	3 00
Course 52	3 00
Course 54	2 00
Course 75	3 00
Course 76	3 00
Course 77	3 00
Course 79	2 00
Music (each course)	3 00
Rural home life: —	
Courses 25, 26, 27	1 50
Courses 50, 51, 52	4 00

Rooms.

Students are expected, as far as possible, to occupy rooms in the college dormitories. Students who do not live in the college dormitories must secure rooms approved by the college. The assignment of rooms, and the general supervision of the housing of students, is in charge of the dean. At the end of each college year all unoccupied rooms will be thrown open for selection, and will be assigned to students according to classes.

Living Accommodations for Women Students.

Women students attending the college live in a dormitory provided for them, and take their meals at Draper Hall, which is located a short distance from the women's dormitory. The women's dormitory accommodates 98 girls, and is furnished. The present charge for room and board for women students is $120 per term.

Student Aid.

Self Help. — Many students are obliged to find work of some sort to earn their way through college. A few men have met their entire expenses in this manner, many more have paid a large part of their expenses, and many have earned a small proportion of the cost of their college education; but the college recommends that no new student enter without having at least $200 and preferably $300 with which to pay his way until he can establish himself in some regular work. The college does not encourage students to enter without money in the expectation of earning their way entirely. The ordinary student will find it better either to work and accumulate money before coming to college, or to take more than four years in completing his college course, or, instead, to borrow money sufficient to carry him through. No student should undertake work that interferes with his studies, and students should understand that, owing to the large number of applications for employment, no one man can receive a large amount of work at the college. A number of students find opportunities for earning money without depending upon the college to furnish them with work.

So far as possible needy students will be employed in some department of the college. The divisions of agriculture and horticulture usually afford the most work, although there are several permanent janitorships available for students, and forty or more students are employed at the dining hall.

Application for student labor should be made directly to Kenyon L. Butterfield, president of the college. Students whose deportment or class work is not satisfactory are not likely to be continued in student labor. The most desirable and responsible positions are naturally assigned to those needy students who have been in the institution

longest and who have demonstrated their need and ability. Students, therefore, may find it rather difficult to obtain all the work they desire during their freshman year; as a matter of fact, however, any student who is capable of doing a variety of things, and who is a competent workman, usually finds little difficulty in obtaining all the work that he can do from the outset.

Special Notice to Needy Students. — In the last few years the demand for paid labor on the part of new students has far exceeded the amount of employment that the college can offer. The college cannot promise work to any student, particularly to freshmen; it accordingly urges prospective students who are dependent entirely upon their own efforts not to undertake the course before they have earned enough money to carry them through, or nearly through, the first year.

Memorial Hall.

Soon after the close of the World War the alumni, students, faculty and friends of the college subscribed $150,000 for the erection of a soldier memorial building to be placed on the college campus. This building was completed in the summer of 1921. It is designed to serve as headquarters for the student activities, and as the center of the social life of the institution.

In the basement are bowling alleys, pool tables, a store, post office and barber shop. On the main floor are eight offices for leaders of various student activities, a large reading room, and a beautiful memorial room in which is found the tablet bearing the names of the sons of the college who gave their lives in the great war. On the second floor is an auditorium seating 350 persons. This room is also used for college dances.

Student Accounts.

The following rules are enforced concerning student accounts: —

No student will be allowed to graduate until all bills due the institution from him are paid.

College charges, such as room rent, laboratory fees and tuition, must be paid in advance, at the beginning of each term. This rule is strictly adhered to, and no student will be allowed to complete his registration until such payments are made.

Every student boarding at Draper Hall is required to pay at the beginning of each term at least one month's board in advance; and no student will be allowed to continue to board at Draper Hall if at any time during the term he is more than one week in arrears in his payment for board.

All money due for student labor shall at the discretion of the treasurer of the college be applied on account toward any bills that a student may owe to the institution.

Honor Council.

All tests and examinations are conducted under the honor system, which is administered by an Honor Council chosen by the students. Recommendations for discipline are made to the president of the college by the Honor Council.

Student Relations.

The customary high standard of college men in honor, manliness, self-respect and consideration for the rights of others constitutes the standards of student deportment.

The privileges of the college may be withdrawn from any student at any time, if such action is deemed advisable.

It should be understood that the college, acting through its president or any administrative officer designated by him, distinctly reserves the right, not only to sus-

pend or dismiss students, but also to name conditions under which students may remain in the institution. For example, if a student is not doing creditable work he may not only be disciplined but he may also be required to meet certain prescribed conditions in respect to his studies, even though under the foregoing rules his status as a student be not affected. The same provision applies equally to the matter of absences ("cuts"). According to the rules a student is allowed a certain percentage of absences from class and other exercises. This permission, which implies a privilege and not a right, may be withdrawn at any time for any cause.

Similarly, also, it applies to participation in student activities. Though this will ordinarily be governed by the rules as already laid down, yet, if in the judgment of the college authorities a student is neglecting his work on account of these activities, the privilege of participating in them may be withdrawn for such time as is considered necessary. Moreover, it may be withdrawn as a punishment for misconduct. Prospective students or their parents may, upon application, obtain a copy of the faculty rules governing student relations to the college.

Infirmary.

The college maintains an infirmary for the care of sick or injured students.

The buildings now available for this purpose are quite inadequate for the needs of the institution, and it is hoped that in the near future other buildings of this kind may be erected and the general equipment somewhat amplified. At present two small buildings, built especially for hospital purposes, are used for the infirmary.

The following statement outlines the plan followed in the management of the infirmary with respect to students: —

Management of the Infirmary.

Supervision.

1. The infirmary is under the *general supervision* of Prof. Charles E. Marshall, who is designated as Supervisor of the Infirmary. A resident nurse is in *immediate* charge of the infirmary.

Use of Infirmary.

2. Students are urged to go to the infirmary at any time that they are in need of the services rendered by the resident nurse or by a town physician. Inasmuch as the physical director gives special attention to all student diseases, it is to be expected that the majority of the students will go to the infirmary at his suggestion. This understanding, however, should in no way deter students from going to the infirmary voluntarily at any time.

General Health.

3. Students are urged to consult the physical director or the resident nurse immediately when signs of physical disorder appear. Severe attacks of cold or other forms of illness can usually be avoided if treatment is administered in the incipient stage. The purpose of the infirmary is to help maintain the general good health of the students, as well as to furnish a suitable place for professional attention in cases of severe illness or accident.

General Fee.

4. The infirmary fee will be at the rate of $2 a day, and will be charged when one or more meals are obtained at the infirmary, or when the student remains at the infirmary for one or more nights. A nominal charge will be made to out-patients for miscellaneous treatment of a minor character.

Additional Expenses.

5. In addition to the fee charged, as specified in paragraph 4, the following additional expenses will be charged to the patient: —

(*a*) *Nurses.* — In case a special nurse is required for the proper care of an individual, the services and board of this nurse will be paid by the patient. Such a nurse will be under the general supervision of the resident nurse.

(*b*) *Professional Service.* — If a student requires medical attention by a physician, he will be required to select his physician and become responsible for fees charged by the physician.

(*c*) *Supplies.* — Special medical supplies prescribed by a physician or nurse will be charged to the patient.

(*d*) *Laundry.* — Expense for personal laundry incurred by students while in the infirmary will be charged to the individual student.

B. COLLEGE ACTIVITIES.

General Exercises.

Chapel exercises are held two mornings each week. On Thursdays during the fall term, and on Wednesdays during the winter and spring terms, an afternoon assembly is held, to which some prominent layman or professional man is invited to speak. The object of these assemblies is to bring to the students discussions of topics of present-day interest. A special chapel service on Sunday is held during the winter months. Students are required to attend these general exercises, although the president is authorized to excuse from chapel any student who may object to attendance thereon because of his religious scruples, provided his request for excuse therefrom is endorsed by his parent or guardian.

Student Activities.

A large number of student organizations furnish opportunity to students for work and leadership.

The Massachusetts Agricultural College Social Union was established in 1907. All students become members of the union by paying a small fee. In the fall and winter months the union gives a series of entertainments, free to students and faculty.

The College Senate is composed of representatives of the junior and senior classes. This body serves as a general director of undergraduate conduct, and represents before the faculty the interests of the student body.

The Young Men's Christian Association and the Young Women's Christian Association are active both socially and religiously. A Catholic club has also been organized.

Intercollegiate and intermural athletic contests are held throughout the year in the leading sports, including football, baseball, track, hockey and basketball. The athletic board, composed of alumni, faculty and students, has charge of finances, schedules, and general policies governing athletics.

The musical clubs include an orchestra and a glee club.. These give a number of concerts, usually followed by dancing, during the year, both in Amherst and on tour. A dramatic club, The Roister Doisters, present annually a revue and two plays, one in connection with the promenade and the other at commencement. There are, besides the declamation and oratorical prize contests, both underclass and intercollegiate debates. The college is a member of a triangular league with Rhode Island and Connecticut. The college publications are the "Massachusetts Collegian," the weekly newspaper; "The Index," the year book; "The Squib," a comic magazine; and "The Alumni Bulletin," issued from the office of the alumni secretary. The Academic Activities Board, composed of alumni, faculty and students, has charge of the finances, schedules, etc., of the various clubs and publications.

A rifle club has been organized for a few years. Teams representing this club have repeatedly won the intercollegiate championship of the country, both in indoor and outdoor contests.

C. ACADEMIC AND DEPARTMENTAL.

Degrees.

Those who complete a four-year course receive the degree of bachelor of science. The fee for graduation from the college is $5.

Graduate students who complete the assigned courses will receive the degree of master of science upon the payment of a fee of $10. Credit may sometimes be allowed towards this degree for teaching or other advanced work done in some department of the college.

Graduate students who complete the required three-year course of study, and present a satisfactory thesis, will be granted the degree of doctor of philosophy.

Those to whom degrees are awarded must present themselves in person at commencement to receive them. No honorary degrees are conferred.

The honorary fraternity of Phi Kappa Phi has a chapter at the agricultural college. Students are elected to membership to this fraternity on the basis of scholarship. Elections are made from the highest tenth of the senior class who have attained an average grade of at least 85 per cent during their college course.

Prizes.

Prizes are given annually in several departments for excellence in study or for other special achievement. Prizes awarded in 1923 were: —

Grinnell Prizes. — The Grinnell prizes, given by the Hon. William Claflin of Boston in honor of George B. Grinnell, Esq., of New York, to those members of the senior class who pass the best, second best and third best examinations, oral and written, in theoretical and practical agriculture, were awarded as follows: —

First prize, Trescott Tupper Abele.

Second prize, Warren Hannaford Towne.

Third prize, Robert Brooks Bates.

Public Speaking. — The Burnham prizes were awarded to the students delivering the best and second best declamations, as follows: —

First prize, George Lyle Church, 1925.

Second prize, James Batal, 1925.

Flint Prizes. — The Flint prizes were awarded to the student delivering the best oration, as follows: —

First prize, Alexander Sandow, 1923.

Second prize, Benjamin Gamzue, 1923.

Hills Prizes. — The Hills prizes for the best herbaria were awarded as follows: —

First prize, George Lyle Church, 1925.

Second prize, George Francis Shumway, 1925.

Southern Alumni Baseball Cup. — For the best all-round baseball player during the season of 1922 the Southern Alumni baseball cup was awarded to Howard Reynolds Gordon, 1923.

Allen Leon Pond Memorial Medal, for Excellence in Football. — The Allen Leon Pond memorial medal for general excellence in football was awarded to Wilbur Horace Marshman, 1923. This medal is in memory of Allen Leon Pond of the class of 1920, who died Feb. 26, 1920.

Degrees Conferred — 1923.

Master of Science (M.Sc.).

Ali, Mehmed, B.A., International College, Smyrna	Smyrna, Asia Minor.
Flikkema, Renzy Evert, A.B., Hope College	Morrison, Ill.
French, Arthur Perkins, B.Sc., Ohio State University	Amherst.
Parker, John Robert, B.Sc., Massachusetts Agricultural College	Bozeman, Montana.
Potter, David, B.Sc., Massachusetts Agricultural College	Concord.
Tietz, Harrison Morton, B.Sc., Massachusetts Agricultural College	Richmond Hill, N. Y.
Tipple, Esther Watson, B.Sc., Teachers College, Columbia University	Valparaiso, Ind.
Worthley, Harlan Noyes, B.Sc., Massachusetts Agricultural College	Amherst.
Yount, Hubert William, B.Sc. in Agr., Ohio State University	Toledo, Ohio.

Master of Agriculture (M.Agr.).

Lowe, Chinghsi Hiram, B.A., Peking University, B.Sc., University of Illinois	Chinwangtao, North China.
Rice, Victor Arthur, B.Sc., North Carolina State College	Amherst.

Doctor of Philosophy (Ph.D.).

Serex, Paul, Jr., B.Sc., M.Sc., Massachusetts Agricutural College	Amherst.

Bachelor of Science (B.Sc.).

Abele, Trescott Tupper	Quincy.
Alger, Mason Williams	West Bridgewater.
Arrington, Luther Bailey	Florence.
Baker, Howard	Marshfield.
Bateman, Eleanor Willard	Arlington.
Bates, Howard	Cohasset.
Bates, Robert Brooks	West Springfield.
Beal, James Allen	Abington.
Bennett, James Stanley	South Meriden, Conn.
Boles, Inza Almena	Dorchester.
Brewer, Gardner Hunter	Upton.
Broderick, Lawrence Francis	Hyde Park.
Buckley, Francis Edward	Natick.
Burke, Edmund William	Watertown.
Cohen, Saul	Dorchester.
Collins, Donald Keith	Rockland.
Cook, Frederick Belcher	Niantic, Conn.
Corash, Paul	Worcester.
Dickinson, Lewis Everett, Jr.	Holyoke.
Dowden, Philip Berry	Sandwich.
Faneuf, John Benedict	West Warren.
Fitzpatrick, Leo Joseph	Brockton.
Folsom, Owen Eugene	Roslindale.
Friend, Roger Boynton	Dorchester.
Fuller, Robert Donald	Woburn.
Gamzue, Benjamin	Holyoke.
Gerry, Bertram Irving	Peabody.
Gildemeister, Mary Katherine	Belchertown.
Giles, Clifton Forrest	Newtonville.
Gold, Philip	Lynn.
Gordon, Howard Reynolds	Ipswich.
Graves, George	Granville, Ohio.
Grayson, Raymond Henry	Milford.
Hale, John Stancliff	South Glastonbury, Conn.
Hallett, Melvin Bernard	Rockland.

Harrington, Robert John	Holyoke.
Heath, Allan Jay	Newfane, Vt.
Hilyard, Norman Douglas	Beverly.
Hodsdon, Marshall Sinclair	Melrose Highlands.
Holley, George Gilbert	Fiskdale.
Hollis, Frederick Allen	Charlton.
Hunter, Henry Leander, Jr.	Pleasantville, N. Y.
Irish, Gilbert Henry	Turner, Me.
Johnson, Cleon Bancroft	Ipswich.
Johnson, Eyrle Gray	Mattapan.
Lewis, Molly LeBaron	Jamaica Plain.
Lindskog, Gustaf Elmer Richard	Roxbury.
Luddington, Frank Dennison	Hamden, Conn.
MacCready, Donald Eugene	Elizabeth, N. J.
Marshall, Alexander Borea	Greenwich, Conn.
Marshman, Wilbur Horace	Springfield.
Martin, Frances Barbara	Amherst.
Martin, Robert Fitz-Randolph	Amherst.
Mather, Edna	Amherst.
Minor, John Bacon, Jr., as of the class of 1918	Amherst.
Mohamedi, Sageer	India.
Mohor, Robert deSales	Newton Centre.
Mudgett, Vernon Downer	Brookline.
Newell, Richard Carll	West Springfield.
Norcross, Harry Cecil	Brimfield.
Nowers, Donald Gilford	Danvers.
Paddock, Wallace Earl	Worcester.
Picard, Charles Francis	Plymouth.
Richards, Homer Flint	Littleton.
Richardson, Mark Morton	West Brookfield.
Roberts, Arthur William	Hyde Park.
Russell, Charles Francis	Winchendon.
Sandow, Alexander	Pittsfield.
Sargent, Richmond Holmes	Winthrop, Me.
Sears, Fred Grant, Jr.	Dalton.
Sharpe, Charles Gertner	Amherst.
Shea, Thomas Francis	Holyoke.
Shumway, Paul Edward	Greenfield.
Slade, Irving Woodman	Chelsea.
Smith, Jeffrey Poole	West Roxbury.
Snow, Thomas Lathrop	Greenfield.
Tanner, Edwin	Worcester.
Tarr, James Gordon	Gloucester.
Tisdale, Edward Norman	Medfield.
Towne, Carroll Alden	Auburndale.
Towne, Warren Hannaford	Cambridge.
Tumey, Malcomb Edward	Deerfield.
Turner, Dorothy VanHoven	Washington, D. C.
Wendell, Richard Goodwin	Belmont.
Whitaker, Holden	Newton Highlands.
Whittier, John McKey	Brookline.
Williams, Forrest Earl	Sunderland.
Wirth, Conrad Louis	Minneapolis, Minn.
Woodworth, Leverett Stearns	Newton.

Registration, 1923-24.

As of November 1, 1923.

Graduate Students.

Archibald, John G. . . . . Amherst.
B.S.A., Ontario Agricultural College, Toronto University.
Arrington, Luther B. . . . . Florence.
B.Sc., Massachusetts Agricultural College.
Avery, Roy C. . . . . Amherst.
B.Sc., Connecticut Agricultural College.
M.Sc., Massachusetts Agricultural College.
Bailey, John S. . . . . Amherst.
B.S., Michigan Agricultural College.
M.S., Iowa State College.
Baron, H. Marshall . . . . Ottawa, Ontario, Canada.
B.S.A., Ontario Agricultural College, Toronto University.
Bromley, Stanley W. . . . . Southbridge.
B.Sc., Massachusetts Agricultural College.
Buchanan, Walter G. . . . . Bernardston.
B.Sc., Massachusetts Agricultural College.
Campbell, Walter J. . . . . Springfield.
A.B., M.A., Princeton University.
Cassidy, Morton H. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Chase, Eleanor F. . . . . Amesbury.
B.Sc., Massachusetts Agricultural College.
Degener, Otto . . . . New York, N. Y.
B.Sc., Massachusetts Agricultural College.
M.Sc., University of Hawaii, Honolulu.
Dickinson, Lawrence S. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Doran, William L. . . . . Lexington.
B.Sc., Massachusetts Agricultural College.
Emery, Herbert M. . . . . Durham, N. H.
B.Sc., Massachusetts Agricultural College.
Foss, Philip E. . . . . Amherst.
B.S., Bowdoin College.
Freeborn, Stanley B. . . . . Berkeley, California.
B.Sc., Massachusetts Agricultural College.
Frellick, Arthur L. . . . . Everett.
B.Sc., Massachusetts Agricultural College.
Frellick, Ralph S. . . . . Brockton.
B.Sc., Franklin College.
French, Arthur P. . . . . Amherst.
B.Sc., Ohio State University.
M.Sc., Massachusetts Agricultural College.
Garabedian, Hovanes . . . . Smyrna, Asia Minor.
B.A., International College, Smyrna.
Garvey, Mary E. M. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Gibbard, James, Jr. . . . . Toronto, Ontario, Canada.
B.S.A., Ontario Agricultural College, Toronto University.
Gilligan, Gerald M. . . . . West Warren.
B.Sc., Massachusetts Agricultural College.
Hall, Merwin P. . . . . Brookline.
A.B., Amherst College.

Harris, Roy D. . . . . Amherst.
B.Sc., Middlebury College.
Hayes, Frank A. . . . . Amherst.
B.Sc., Oklahoma Agricultural and Mechanical College.
M.A., University of Nebraska.
Ph.D., Iowa State College.
Hodgdon, Julia P. . . . . Hannibal, Mo.
B.A., Smith College.
Johnson, Waldemar C. . . . . Elk Rapids, Mich.
B.Sc., Michigan Agricultural College.
Jones, Willard P. . . . . Black River Falls, Wis.
B.S., University of Wisconsin.
Julian, Arthur N. . . . . Amherst.
B.A., Northwestern University.
Lanphear, Marshall O. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Loring, William R. . . . . Hadley.
B.Sc., Massachusetts Agricultural College.
Louwsma, Henry . . . . Zeeland, Mich.
A.B., Hope College.
Mack, Merrill J. . . . . Bangor, Pa.
B.S., Pennsylvania State College.
Mack, Warren B. . . . . Flicksville, Pa.
Ph.B., LaFayette College.
B.Sc., Pennsylvania State College.
Meserve, Charles A. . . . . Livermore Falls, Me.
B.Sc., Massachusetts Institute of Technology.
Ph.D., University of Erlangen, Bavaria.
Michels, Charles A. . . . . Amherst.
B.Sc., North Dakota Agricultural College.
Mooney, Raymond A. . . . . Plattsburg, N. Y.
B.Sc., Massachusetts Agricultural College.
Morgan, Ezra L. . . . . Columbia, Mo.
A.B., McKendree College.
M.A., University of Wisconsin.
Muller, Richard T. . . . . Amherst.
B.S., Cornell University.
M.S., University of Maine.
Novitski, Joseph F. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Pendleton, Harlow L. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Pulley, Marion G. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Raleigh, George J. . . . . Amherst.
B.S. in Agr., Kansas State Agricultural College.
M.S., University of Nebraska.
Redman, Ralph W. . . . . Amherst.
B.S., University of Maine.
Reed, James P. . . . . Hadley.
B.S., University of Vermont.
Rice, Victor A. . . . . Amherst.
B.Sc., North Carolina State College.
M.Agr., Massachusetts Agricultural College.
Rikert, Carroll . . . . Mount Hermon.
B.A., Harvard University.
Robertson, William F. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Rogers, Roland W. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Sanborn, Ruby . . . . Amherst.
A.B., Mt. Holyoke College.
Sanborn, Joseph R. . . . . North Amherst.
B.Sc., Massachusetts Agricultural College.
Sanctuary, William C. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.

Simmons, Kenneth B. . . . . Rowesville, S. C.
B.S., Clemson College.
Smith, Richard W., Jr. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Snyder, Grant B. . . . . Amherst.
B.S.A., Ontario Agricultural College.
Steere, Paul L. . . . . Waterbury, Conn.
B.S., Connecticut Agricultural College.
Thelin, Guy . . . . Amherst.
B.Sc., South Dakota State College.
Tietz, Harrison M. . . . . Richmond Hill, N. Y.
B.Sc., M.Sc., Massachusetts Agricultural College.
Van Meter, Ralph A. . . . . Amherst.
B.S., Ohio State University.
Wallace, Anna M. . . . . Amherst.
A.B., Smith College.
A.M., Smith College.
Willard, John D. . . . . Amherst.
B.A., Amherst College.
Williams, Edward K. . . . . Outremont, Quebec, Can.
P.S.A., Macdonald College, McGill University.
Williamson, Harold F. . . . . Amherst.
B.S.A., Macdonald College, McGill University.
Worthley, Harlan N. . . . . Amherst.
B.Sc., M.Sc., Massachusetts Agricultural College.
Yount, Hubert W. . . . . Amherst.
B.Sc.Agr., Ohio State University.
Zahir, Alfred . . . . Amritsar, India.
B.A., St. Stephens College, University of Punjab.
M.A., Columbia University.

Registered after the Catalogue for 1922 was published.

Bailey, John S. . . . . Lakewood, Ohio.
B.S., Michigan Agricultural College.
M.S., Iowa State College.
Burnham, Edwin G. . . . . Springfield.
B.Sc., Massachusetts Agricultural College.
Cook, Frederick B. . . . . Niantic, Conn.
B.Sc., Massachusetts Agricultural College.
Friend, Roger B. . . . . Dorchester.
B.Sc., Massachusetts Agricultural College.
Gray, Thomas D. . . . . Morgantown, W. Va.
B.S., Maryland Agricultural College.
Lacroix, Donald S. . . . . Byfield.
B.Sc., Massachusetts Agricultural College.
Lawrence, Robert P. . . . . East Greenwich, R. I.
B.Sc., Massachusetts Agricultural College.
Pendleton, Harlow L. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Redman, Ralph W. . . . . Amherst.
B.S., University of Maine.
Rikert, Carroll . . . . Mount Hermon.
B.A., Harvard University.
Tanner, Edwin . . . . Worcester.
B.Sc., Massachusetts Agricultural College.
Zahir, Alfred . . . . Amritsar, India.
B.A., St. Stephens College, University of Punjab.
M.A., Columbia University.

Class of 1924.

Barrows, Robert Arthur	Quincy	Lambda Chi Alpha.
Bartlett, Frederick Sheldon	Westfield	Sigma Phi Epsilon.
Bartlett, Perry Goodell	Holyoke	Lambda Chi Alpha.
Bartlett, Warren Leslie	Boston	Phi Sigma Kappa.
Belden, Clifford Luce	Bradstreet	Kappa Sigma.
Bike, Edward Louis	Westfield	Sigma Phi Epsilon.

Bittinger, Richard	Northfield	Sunset Avenue, care of Professor Banta.
Bowes, Charles Atwell	Worcester	Q. T. V.
Brunner, Fred, Jr.	Cranbury, N. J.	Phi Sigma Kappa.
Burbeck, Joseph Howard	Peabody	Sigma Phi Epsilon.
Cahalane, Victor Harrison	Charleston, N. H.	Alpha Sigma Phi.
Carpenter, Earle Stanton	Rehoboth	Alpha Sigma Phi.
Chase, Theodore Martin	Livermore Falls, Me.	Phi Sigma Kappa.
Cromack, Earl Augustus	Shelburne Falls	Theta Chi.
Darling, Robert Martin	Cambridge	Q. T. V.
Davis, Howard Halsey	Brockton	Lambda Chi Alpha.
Deuel, Charles Frederick, 2d	Amherst	Q. T. V.
Dimock, Walter Lewis	Oxford	Theta Chi.
Dresser, Allen Lucius	Amherst	Q. T. V.
Elliott, James Alexander	Summit, N. J.	Care of Geo. Cooley, Sunderland.
Emery, George Edward	Marlborough	Sigma Phi Epsilon.
Epps, Martha Belle Scott	Winchendon	Abigail Adams House.
Fenton, John Michael	Amherst	108 Pleasant Street.
Fernald, Leland Hoyt	Arlington	Lambda Chi Alpha.
Flint, Ruth Guild	Allston	Abigail Adams House.
Foley, Mary Joanna	Worcester	Abigail Adams House.
Frost, Sherman Clark	Cambridge	Sigma Phi Epsilon.
Frost, Willard Chamberlain	Milford	Theta Chi.
Gadsby, James Herbert	North Adams	Q. T. V.
Garretson, Alfred Corwin	Bound Brook, N. J.	Phi Sigma Kappa.
Gay, Alfred Fullick	Groton	Theta Chi.
Geiger, Aimée Suzanne	Pepperell	Abigail Adams House.
Goldsmith, Eliot Gray	Brookline	Kappa Sigma.
Goldstein, Joseph	Lynn	14 South College.
Grieve, Alexander Watson	Dorchester	Alpha Gamma Rho.
Gryzwacz, Patrick Louis	Ware	Kappa Gamma Phi.
Haskell, Malcolm Rawson	Amherst	Kappa Sigma.
Hayden, Luther Leonard, Jr.	Brookville	Stockbridge Hall.
Hill, Carroll Victor	Worcester	Lambda Chi Alpha.
Holway, Clarence Warren	Putney, Vt.	Alpha Sigma Phi.
Hubbard, Doris	Newton	Abigail Adams House.
Isaac, Carl Frederick	Brighton	Alpha Gamma Rho.
James, Locke LeBaron	West Bridgewater	Alpha Gamma Rho.
Kane, Edward Anthony	Westfield	Q. T. V.
Keith, Clifford Woodworth	East Providence, R. I.	Theta Chi.
King, Rosewell Howard	Millville	Alpha Sigma Phi.
Labrovitz, Rose Florence	Amherst	11 Amity Street.
Lamb, Eric Franklin	Waban	Theta Chi.
Lane, Wilfred Craig	Fitchburg	Kappa Gamma Phi.
Leland, Allen Sanford	East Bridgewater	Alpha Gamma Rho.
Loring, Kenneth Stockwell	Melrose Highlands	Lambda Chi Alpha.
MacAfee, Norman Hoar	Cambridge	Alpha Gamma Rho.
Morris, Walter Markley	Amherst	44 Triangle Street.
Myrick, Sterling	Longmeadow	Lambda Chi Alpha.
Nelson, Carl Olaf	Gloucester	Alpha Gamma Rho.
Nicoll, Arthur Chester	Quincy	Lambda Chi Alpha.
Norwood, Howard Lester	Boston	101 Butterfield Terrace.
Noyes, Russell	Newton Centre	Theta Chi.
Percival, Gordon Pittinger	Medfield	Alpha Gamma Rho.
Perry, Chauncy Valentine	Waltham	Theta Chi.
Perry, John Tuttle	Waltham	Alpha Sigma Phi.
Pierce, Arthur Edwin	Newtonville	Phi Sigma Kappa.
Porges, Nandor	Hyde Park	13 South College.
Pratt, Wallace Francis	Rockland	Alpha Gamma Rho.
Read, John Gammons	Springfield	3 North College.
Regan, Leon Ashley[1]	Walpole	Alpha Sigma Phi.
Reynolds, Joseph Sagar	Attleboro	Theta Chi.
Rhodes, Winthrop Gordon	Waban	Theta Chi.
Ricker, Chester Sewall	Worcester	Alpha Sigma Phi.

[1] Special senior.

Rowell, Elwyn Joseph	Amherst	44 Triangle Street.
Salman, Kenneth Allen	Needham	Lambda Chi Alpha.
Schaffer, Carlton Hill	Ashfield	Alpha Gamma Rho.
Sellers, Wendell Folsom	Melrose	Alpha Gamma Rho.
Shepard, Harold Henry	Athol	Kappa Epsilon.
Sims, Kenneth Wallace	South Boston	Alpha Gamma Rho.
Smith, Richard Burr	Greenfield	Phi Sigma Kappa.
Steele, Charles Wasser	Marblehead	Lambda Chi Alpha.
Steere, Robert Ernest	Chepachet, R. I.	103 Pleasant Street.
Stevenson, Harold Dudley	Camden, Me.	Alpha Gamma Rho.
Tewhill, Charles James	Florence	Alpha Gamma Rho.
Thornton, Clarence Percy	Pelham	R. F. D. 2.
Varnum, Thomas, Jr.	Lowell	Phi Sigma Kappa.
Walker, Judson Newcombe	Marlborough, N. H.	16 North College.
Waugh, Albert Edmund	Amherst	Kappa Sigma.
Weatherwax, Howard Erle	Greenfield	Theta Chi.
White, Samuel Henry	Orange	Lambda Chi Alpha.
Whitman, Chester Edgerly	Milton, N. H.	Phi Sigma Kappa.
Whitney, Richard Augustine	Brooklyn, N. Y.	Kappa Sigma.
Whitney, Will Alvah	Taunton	3 North College.
Williams, James Lowell	Sunderland	Q. T. V.
Witt, Earl Maynard	Belchertown	Alpha Gamma Rho.
Wood, Ruth Millicent	Hathorne	Abigail Adams House.
Wood, William Wilson	Barre Plains	Theta Chi.
Woodworth, Robert Hugo	Newton	Phi Sigma Kappa.

CLASS OF 1925.

Armstrong, Bradford	Kensington, Md.	The Davenport.
Barnes, Adrian Douglas	South Weymouth	Q. T. V.
Bean, Francis Irving	Bradford	Q. T. V.
Benoit, Helen Anna	Amherst	16 Belchertown Road.
Binner, Roger Stokebill	Amherst	Amherst House.
Bray, Ralph Hastings	Framingham	Sigma Phi Epsilon.
Burhoe, Sumner Othniel	Framingham	42 Lincoln Avenue.
Cahill, Carl Winfield	Newburyport	Kappa Sigma.
Casey, Alice Rita	Fall River	Abigail Adams House.
Cassano, Joseph[1]	Groveland	Q. T. V.
Church, George Lyle	Dorchester	Alpha Gamma Rho.
Cleaves, Leighton Greenwood	Gardner	Phi Sigma Kappa.
Cooke, Robert Gordon	Atlantic	Alpha Sigma Phi.
Corwin, Emil Joseph	East Boston	13 South College.
Crosby, John Samuel	Arlington	Phi Sigma Kappa.
Currier, Leland Little	Marblehead	Alpha Gamma Rho.
Davis, Osborne Ozro	Belchertown	20 South College.
DeVito, Dominick	Roxbury	Kappa Epsilon.
Duffy, Leo Francis	Springfield	Kappa Epsilon.
Ferranti, Edmund Tony	West Bridgewater	Lambda Chi Alpha.
Fish, Donald Otis	Amherst	Kappa Sigma.
Gilbert, Chauncey McLean	North Amherst	North Amherst.
Gleason, Harold Albert	Chester	Phi Sigma Kappa.
Gordon, Solomon	Boston	9 South College.
Grover, Walter Champion	Bernardston	Phi Sigma Kappa.
Guterman, Carl Edward Frederick	Springfield	Kappa Sigma.
Haeussler, Gilbert Julius	Springfield	Kappa Sigma.
Hale, Laurence Newton	South Glastonbury, Conn.	Phi Sigma Kappa.
Hanscomb, George Wilmont	North Attleborough	Lambda Chi Alpha.
Harris, Clarence Albert	Utica, N. Y.	4 Chestnut Street.
Helteen, John Gunnar	Quincy	Kappa Gamma Phi.
Hyde, John Worthington	Amherst	55 Pleasant Street.
Ingraham, Edward Forster	Millis	Sigma Phi Epsilon.
Kakavas, James Christo	Lowell	2 North College.
Keith, Lewis Hayden	Bridgewater	Kappa Sigma.
Kennedy, Lowell Francis	Cambridge	Q. T. V.
Lacey, John Sebastian	Holyoke	13 Elm Street, Holyoke.

[1] Special junior.

Lavallee, Louis Palmer	Worcester	5 Nutting Avenue.
Lord, John Frederic	Methuen	Alpha Sigma Phi.
Love, Andrew Wyllie	Auburn	Alpha Gamma Rho.
Lunt, Samuel Wilde	Cumberland Center, Me.	Kappa Sigma.
Mahoney, Walter Francis	Millville	Alpha Sigma Phi.
Marx, Herbert John	Holyoke	Kappa Epsilon.
McGeoch, Charles Ryerson	Providence, R. I.	Kappa Epsilon.
Meserve, George Donald	Hudson	Lambda Chi Alpha.
Mouradian, Garabed Kevork	Bridgewater	Q. T. V.
Moxon, David	Holyoke	Kappa Epsilon.
Nelson, Paul Redfield	Holyoke	84 Pleasant Street.
O'Connor, Arthur Maxwell	Amherst	Mount Pleasant.
Oliver, Charles Frank, Jr.	Brockton	Lambda Chi Alpha.
Parker, Donald Llewellyn	North Adams	Sigma Phi Epsilon.
Peirce, Veasey	Dorchester	Phi Sigma Kappa.
Peltier, Xavier Paul	Spencer	Q. T. V.
Poey, Frederick	Havana, Cuba	15 South College.
Root, Frank Edson	Bernardston	Alpha Gamma Rho.
Ross, Charles Frederick	Lee	Sigma Phi Epsilon.
Ross, Donald Ernest	Amherst	19 Woodside Avenue.
Rowley, Harold Frederick	West Wareham	15 Hallock Street.
Samuels, Samuel Bernhard	Holyoke	14 South College.
Sazama, Robert Francis	Northampton	Alpha Sigma Phi.
Sheridan, Irwin Scott	Mansfield	Alpha Gamma Rho.
Shumway, George Francis	Monson	Physics Bldg.
Simpson, Gilbert	Holyoke	8 Allen Street.
Slack, Marion Florence	Allston	Abigail Adams House.
Slowen, William Arnold	Shelburne Falls	Physics Bldg.
Smith, Emily Greenwood	Lee	Abigail Adams House.
Sprague, Dudley deRochemont	Melrose	16 South College.
Taube, Gustave	New York, N. Y.	9 South College.
Taylor, Milton Wight	Chatham	Kappa Sigma.
Templeton, Robert James	Boston	Lambda Chi Alpha.
Ward, Gordon Hugh	Englewood, N. J.	Alpha Gamma Rho.
Whittum, Walter Willard	Springfield	Kappa Gamma Phi.
Wilcox, Stanley Dewey	Springfield	Kappa Gamma Phi.
Woodbury, Samuel Lawrence	Springfield	Alpha Gamma Rho.
Zwisler, Frederick Fisher	Holyoke	Kappa Epsilon.

CLASS OF 1926.

Adams, Kathleen Poland	Worcester	Abigail Adams House.
Albertini, Paul Flanders	Billerica	6 Nutting Avenue.
Anderson, Leslie Clayton	East Bridgewater	Lambda Chi Alpha.
Baker, Francis Everett	Hopkinton	Phi Sigma Kappa.
Baker, Frederic Allen	Springfield	Phi Sigma Kappa.
Barber, Elmer Everett	Jamaica Plain	Kappa Epsilon.
Barnes, Russell Norris	Wallingford, Conn.	Sigma Phi Epsilon.
Bartlett, Herbert Franklin	West Springfield	30 North Prospect St.
Beem, Merrill Adelbert	Woodfords, Me.	46 Pleasant Street.
Block, Harry William	Cambridge	North College.
Bosworth, Marguerite Rose	Holyoke	Abigail Adams House.
Bosworth, Maude Elinor	Holyoke	Abigail Adams House.
Bower, James, Jr.	Holyoke	Kappa Epsilon.
Boyd, Mary Turck	Jacksonville, Fla.	Abigail Adams House.
Brougham, Earl Gordon	Holyoke	12 North College.
Bruorton, Earle Wallace	Reading	Sigma Phi Epsilon.
Buckley, Arthur Vincent	Natick	Kappa Sigma.
Budge, William Karl	Mattapan	7 North College.
Burnham, James Erastus	Springfield	Lambda Chi Alpha.
Burt, Stanley Lyman	Easthampton	Alpha Sigma Phi.
Cassidy, Marion Stewart	Wellesley	Abigail Adams House.
Clark, Charles O'Reilly	Beachmont	Sigma Phi Epsilon.
Collier, William Wellington	Hopedale	83 Pleasant Street.
Cook, Wendell Burnham	Townsend	West Experiment Station.
Cooke, Helen Beatrice	Boston	Care of Professor Yaxis, Sunset Avenue.

Cormier, Francis Joseph [1]	Newtonville	Phi Sigma Kappa.
Couhig, Philip Henry	Beverly	Q. T. V.
Cromack, Aaron Field	Shelburne Falls	M. A. C. Box 110.
Cutler, Samuel	Springfield	13 South College.
Davenport, Preston Julian [2]	Shelburne Falls	17 Fearing Street.
Davis, Evelyn Louise	Springfield	Abigail Adams House.
Dean, Lecil Wallace	West Palm Beach, Fla.	15 North College.
Dick, Ernest Albert	Lawrence	7 North College.
Dodge, Eliot Perkins	Beverly	Theta Chi.
Doolittle, Alden Hartwell	Northfield	Aggie Inn.
Douglass, Earle Lawrence	Springfield	15 Phillips Street.
Dow, Philip Norman	Bolton	Care of Mr. Everson.
Drake, Dorothy Madeline	Cambridge	Abigail Adams House.
Ducharme, Lucien Henry	Holyoke	15 North College.
Durkee, Lewis Leland	Beverly	18 Nutting Avenue.
Fessenden, Richard William	Middleborough	84 Pleasant Street.
Fitzgerald, Lillian Alice	Holyoke	Abigail Adams House.
Flynn, Alan Foster	Newton	Kappa Epsilon.
Ford, William Warner	Dalton	Stockbridge Hall.
Fraser, Carl Arthur	Westborough	Theta Chi.
Fraser, Harry Edward	Jamaica Plain	Kappa Sigma.
Fuller, Henry Elliot	Melrose	Alpha Gamma Rho.
Galbraith, Leo Lake	South Hadley	Kappa Gamma Phi.
Gavin, Linus Arthur	Natick	Kappa Sigma.
Goodwin, Frederick Tucker	Westfield	Sigma Phi Epsilon.
Goodwin, Marvin Warren	Reading	12 South College.
Gordon, Samuel Francis	Ipswich	Lambda Chi Alpha.
Goren, Louis	Chelsea	14 South College.
Grant, Theodore James	Auburndale	11 South College.
Grayson, Herbert	Milford	83 Pleasant Street.
Greenwood, Elliott Kelton	Hubbardston	M. A. C. Farmhouse.
Gustafson, Alton Herman	Brockton	10 North College.
Hatch, Harold Curtis [1]	Melrose	17 Kellogg Avenue.
Haynes, Walter Lincoln	Springfield	Phi Sigma Kappa.
Hill, Arthur Blair	Walpole	6 Nutting Avenue.
Holbrock, Lester Morse	New Bedford	Lambda Chi Alpha.
Hollingworth, Duncalf Wright	Providence, R. I.	66 Pleasant Street.
Horner, David James	Montpelier, Ohio	29½ Lincoln Avenue.
Howes, Stanley Edward [1]	Brimfield	18 Cottage Street.
Huke, Barbara Allen	South Hadley Falls	Abigail Adams House.
Jack, Melvin Clifton	Amherst	16 Hallock Street.
Jack, Ronald Augustus	Amherst	16 Hallock Street.
Jameson, Matthew	Everett	Kappa Epsilon.
Jensen, Harold Stery	Westfield	Sigma Phi Epsilon.
Johnson, Philip Gordon	Amherst	West Street.
Jones, Alvah Wesley	Salisbury	Kappa Gamma Phi.
Jones, Lawrence Lakin	Brockton	10 North College.
Kafafian, Sarkis Petros [1]	Armenia	11 North College.
Kelso, George	Reading	Sigma Phi Epsilon.
Lambert, John Ford	Gleasondale	West Experiment Station.
Langshaw, Hatton, Jr.	Fairhaven	6 Nutting Avenue.
Larsinos, George John	Westfield	15 South College.
Leedes, Joseph	Philadelphia, Pa.	14 South College.
Lindskog, Hebert Alf	Roxbury	Kappa Epsilon.
Loud, Emery Shaw	Rockland	Theta Chi.
MacMasters, Majel Margaret	Ashburnham	Abigail Adams House.
Mann, Albert Irving	Dalton	Sigma Phi Epsilon.
McNamara, Charles Henry	Stoughton	Kappa Sigma.
Moberg, Herbert Elof	Brockton	12 South College.
Moran, John	Amherst	45 Northampton Road.
Moriarty, John Edward	Ware	15 South College.
Needham, Basil Arthur	Taunton	Sigma Phi Epsilon.
Nichols, Chester Willard	Natick	32 North Prospect Street.
Nickerson, Elsie Elizabeth	East Boston	Abigail Adams House.

[1] Admitted on probation, entrance record incomplete.
[2] Special sophomore.

Norcross, Roy Ellis	Brimfield	16 South College.
Novick, Leo Altschuler	Amherst	56 Pleasant Street.
Noyes, Eliza Margaret	Greenfield	Abigail Adams House.
Otto, Raymond Herman	Lawrence	Kappa Gamma Phi.
Palmer, Cary Davis	Grafton, Vt.	9 North College.
Pomeroy, Elizabeth Clark	Longmeadow	Abigail Adams House.
Potter, Royal Wesley	Providence, R. I.	Phi Sigma Kappa.
Putnam, Ruth Evelyn	Greenfield	Abigail Adams House.
Rainault, Ernest	Holyoke	Kappa Epsilon.
Reed, Charles Porter	Brockton	Lambda Chi Alpha.
Richards, James Marsh	Springfield	Phi Sigma Kappa.
Richardson, Henry Howe	Millis	7 North College.
Roberts, Verne Edward	Willimantic, Conn.	Kappa Epsilon.
Robinson, Clifton Fairbanks	Newtonville	Q. T. V.
Rowen, Edward Joseph	Westfield	Sigma Phi Epsilon.
Sawyer, Roland Damon, Jr.	Ware	9 North College.
Shea, Margaret Catherine	Holyoke	Abigail Adams House.
Simonds, Henry Erving	Winchester	Lambda Chi Alpha.
Smiley, Ray Guild	Worcester	Alpha Sigma Phi.
Smith, Margaret Park	Taunton	Abigail Adams House.
Smith, Myron Newton [1]	Millbury	13 North College.
Smith, Raymond Ellingwood	Manchester	17 Kellogg Avenue.
Sniffen, Loren Fillow	Westport, Conn.	84 Pleasant Street.
Spooner, Raymond Hildreth	Brimfield	M. A. C. Box 129.
Stevens, Alvin Gay	Needham	Kappa Sigma.
Stopford, William Turner	Fort Leavenworth, Kan.	Theta Chi.
Sullivan, Charles Noyes	Fall River	12 North College.
Sullivan, Donald Clifford	Amherst	25 Gray Street.
Sweetland, Augustus Francis	Stoneham	83 Pleasant Street.
Temple, John Burrington	Shelburne Falls	17 Fearing Street.
Tetreault, Albert Joseph	New Bedford	30 Fearing Street.
Thompson, Gerald Thayer	Shelburne Falls	Theta Chi.
Thurlow, George Harold	West Newbury	Kappa Sigma.
Tripp, Kenneth Bliss	Spencer	Kappa Sigma.
Tucker, Edwin Locke	Baldwinsville	Kappa Gamma Phi.
Tulenko, John	Sunderland	Sunderland.
Turner, Charles Edgar	Springfield	8 Mount Pleasant.
Wade, Windsor Burt	Andover	Kappa Gamma Phi.
Walsh, Philip Baker	Amherst	4 Chestnut Street.
Warren, Francis Walter	Stow	Farmhouse.
Waterbury, Arthur Logan	Medford	21 Fearing Street.
Wheeler, Ellsworth Haines	Bolton	Alpha Gamma Rho.
White, Earl Martin	Abington	Kappa Sigma.
White, Montague	West Hartford, Conn.	Q. T. V.
Wilder, Frank Harris	Sterling Jct.	Phi Sigma Kappa.
Williams, Donald Reed	Northfield	Alpha Sigma Phi.
Williams, James Rufus	Glastonbury, Conn.	Q. T. V.
Worssam, Horace Herbert	Bernardston	Q. T. V.

Class of 1927.

Adams, James Prescott	Medway	3 Nutting Avenue.
Ames, Robert Call	Tilton, N. H.	4 Hallock Street.
Amstein, William Gerald	South Deerfield	53 Lincoln Avenue.
Anderson, Andrew Bremer	Hudson	Lambda Chi Alpha.
Ashe, Thomas Edmond	Holyoke	5 North College.
Baker, Philip Woodell	Amherst	124 West Street.
Barney, Laurence Hillman, Jr.	New Bedford	29 North Prospect Street.
Belden, Sanford Oscar [2]	Bradstreet	83 Pleasant Street.
Biron, Raphael Alfred	Amesbury	Theta Chi.
Black, Lewis Herbert	Williamsburg	44 Pleasant Street.
Boden, Frank Joseph	North Wilbraham	29 North Prospect Street.
Bond, Kenneth Carlton	Hyannis	6 Nutting Avenue.
Botulinski, Frank John	Boston	6 North College.
Bovarnick, Max	Chelsea	56 Pleasant Street.

[1] Admitted on probation, entrance record incomplete.
[2] Special freshman.

Bray, Frederick Roland	Amherst	5 Hitchcock Street.
Bray, Walter Abner	Amherst	5 Hitchcock Street.
Briggs, Lawrence Elliott	Rockland	53 Lincoln Avenue.
Britton, William Francis	Neponset	17 Pleasant Street.
Brooks, William Henry, 2d	Holyoke	45 Pleasant Street.
Bruce, Frances Clara	Easthampton	Abigail Adams House.
Buckler, Ella Maud [1]	Pittsfield	Abigail Adams House.
Campion, Thomas Joseph	Amherst	83 Pleasant Street.
Chamberlain, Alexander Rodger	Springfield	83 Pleasant Street.
Chmulra, William	Hadley	Hadley.
Clagg, Charles Floyd	Everett	53 Lincoln Avenue.
Cobb, Roger Madison	North Attleborough	15 Hallock Street.
Connell, Edward Anthony	Malden	60 Pleasant Street.
Cooke, Dorothy Mabel	Atlantic	50 Amity Street.
Crooks, Clarence Arthur	North Brookfield	15 Hallock Street.
Cummings, Maurice Andrew	Cambridge	3 McClellan Street.
Daniels, David Watson	Sherborn	83 Pleasant Street.
Davison, Ruth Eugenia	West Springfield	Abigail Adams House.
DeCamp, George Moon	Winchester	84 Pleasant Street.
Difley, Raymond Frederick	Worcester	51 Amity Street.
Dole, William Levi	Medford	18 Nutting Avenue.
Duperrault, Ralph Adolph	Westfield	15 Phillips Street.
Dyer, Lester Mills [2]	Stoughton	– –
Erickson, Paul Telford [1]	Boston	Care of President Butterfield.
Estes, Wendall Eames	West Duxbury	17 Phillips Street.
Esty, Robert Elliot	Natick	14 North College.
Farwell, Theodore Austin	Turners Falls	83 Pleasant Street.
Field, Rebecca	Montague	Abigail Adams House.
Fish, Laura	Amherst	43 Fearing Street.
Flemings, Frederic James	Sharon	45 Pleasant Street.
Foley, Richard Carol	Portland, Me.	17 Phillips Street.
Galanie, Demetrius Lincoln	Marlborough	7 Phillips Street.
Goldberg, Louis Noah	Wilmington	21 Fearing Street.
Goller, Hilda Margaret	Holyoke	Abigail Adams House.
Goodell, Ruth Edna	Westborough	Abigail Adams House.
Greenaway, James Emerson	Springfield	84 Pleasant Street.
Greenleaf, Margaret Hobart	West Acton	Abigail Adams House.
Griffin, Raymond George	Southwick	15 Phillips Street.
Hamilton, Thomas Arnold	Fair Haven, Vt.	Experiment Station.
Hansen, Niels Jul [1]	Denmark	27 Fearing Street.
Hanson, Daniel Cameron	Dracut	21 Fearing Street.
Harris, Edmund George [1]	Baldwinsville	Kappa Gamma Phi.
Harris, Herbert Joseph	Springfield	84 Pleasant Street.
Hart, Ralph Norwood	Dorchester	Alpha Gamma Rho.
Haskins, Ralph Warner	Greenfield	3 Nutting Avenue.
Hatch, George Franklin, Jr.	West Roxbury	22 Sunset Avenue.
Henneberry, Thomas Vincent	Manchester	8 North College.
Hilyard, Joseph Rayman	Beverly	70 Lincoln Avenue.
Hollinger, Howard Stanley [1]	Springfield	83 Pleasant Street.
Houghton, Allen Ward, Jr.	North Amherst	27 Leverett Street.
Huber, Richard Alden	East Northfield	6 Nutting Avenue.
Hurley, Francis Joseph	Newton Centre	8 Allen Street.
Huthsteiner, Elladora Kathryn	Pittsfield	Abigail Adams House.
Hyde, William Eaton	Amherst	55 Pleasant Street.
Jacoby, Paul Kester	Ashby	30 Fearing Street.
Johnson, Gustaf Arthur	Mount Hermon	44 Pleasant Street.
Kelton, Richard Coolidge	Hubbardston	Farmhouse.
Krassovsky, Leonid Alexander	Russia	116 North Pleasant Street.
Kuzmeski, John William	Amherst	Leverett Street.
Leland, Ralph Chester	East Bridgewater	Farmhouse.
Lenoir, Thomas Benjamin [1]	Greenwood	6 Nutting Avenue.
Levin, Aaron	Malden	– –
MacLaren, Edward Wallace	Sutton	Hatch Barn.

[1] Admitted on probation, entrance record incomplete.
[2] Special freshman.

Manter, Nelson Laird	Clinton	7 Nutting Avenue.
Maxwell, Lewis Joseph	Stoneham	81 Pleasant Street.
McAllister, Robert Wright	North Billerica	21 Fearing Street.
McVey, Ernest Gregory	Dorchester	Care of Mr. Everson.
Merlini, Angelo Albert	North Adams	116 Pleasant Street.
Merrill, Winslow Eaton	Wilmington	84 Pleasant Street.
Milligan, Kenneth William	State Line	101 Pleasant Street.
Moore, Howard Cross	Malden	42 McClellan Street.
Morrill, Alfred Clayton	Natick	81 Pleasant Street.
Mullen, Francis Redding	Becket	17 Fearing Street.
Murdough, Edwin Lincoln	Springfield	Davenport.
Nash, Norman Blake	Abington	70 Lincoln Avenue.
Nottebaert, Harry Charles	Lexington	42 McClellan Street.
Parsons, Clarence Howard	North Amherst	North Amherst.
Parsons, Josiah Waite, Jr.	Northampton	83 Pleasant Street.
Partenheimer, Merrill Henry	Greenfield	14 North College.
Patterson, Jane[1]	Amherst	26 Lincoln Avenue.
Patton, William King	Holyoke	1 North College.
Pickens, Herman Eames	Stoneham	81 Pleasant Street.
Powell, Charles Mason	Brookfield	30 Fearing Street.
Pratt, Martha Elizabeth	Hadley	Hadley.
Pyle, Everett John	Plymouth	21 Pleasant Street.
Reed, James Burbank	Waltham	13 Phillips Street.
Rhoades, Lawrence Duncan	New Marlborough	13 Phillips Street.
Richter, Otto Hermann	Holyoke	7 Phillips Street.
Roberge, Charles Nataline	Williamsburg	44 Pleasant Street.
Robinson, Neil Cooley	Arlington	8 North College.
Russell, Charles Edwin	Dodge	30 Fearing Street.
Savage, Donald Clifford	West Medford	13 Phillips Street.
Sharp, Dallas Lore, Jr.	Hingham	Care of Mr. Everson.
Smith, Willard Elmer	Waltham	13 Phillips Street.
Snow, Osmond Webb	West Springfield	30 North Prospect Street.
Snyder, Allan	Holyoke	1 North College.
Spelman, Albert Francis	New London, Conn.	27 South Prospect Street.
Sullivan, Charles Burke[2]	Fall River	29 North Prospect Street.
Sullivan, William Patrick	Holyoke	3 Allen Street.
Swan, Frederick Walter	North Easton	70 Lincoln Avenue.
Thompson, Arthur Richard	West Bridgewater	6 Nutting Avenue.
Tobey, Edwin Albert	Belmont	13 North College.
VanHall, Walter Bernhardt	Roslindale	M. A. C. Bungalow.
Verity, Herbert Foster	Woburn	27 Fearing Street.
Walker, Almeda Marion	Southbridge	2 Mount Pleasant.
Wardell, Raymond Arthur	Natick	3 Allen Street.
Whitaker, Lewis Harlow	Hadley	Hadley.
White, John Everett	Abington	70 Lincoln Avenue.
Williams, Earl Fletcher	Whitinsville	6 Nutting Avenue.
Wirth, Walter Leon	Minneapolis, Minn.	5 Fearing Street.
Zavorski, Theodore	Easthampton	5 North College.

Special Students.

Burnett, Marston	Cambridge	Wilder Hall.
Cartwright, Calton Oliver	Northampton	75 Pleasant Street.
Coveney, John Joseph	Amherst	Adams Farm.
Delaney, Rose	Holyoke	– –
Hescock, Robert Eddy	Amherst	31 East Pleasant Street.
Hicks, Adeline Elizabeth	Amherst	The Davenport.
Hixon, Allen Wentworth	Worcester	11 South College.
Johnson, Harry	Hynes, Calif.	25 Gray Street.
Kennedy, Maurice Thomas	South Hadley Falls	57 Lamb Street, South Hadley Falls.
Martin, Ural Valentine	Pelham	Harkness Road, Pelham.
Matson, Anna Nathalie	Pasadena, Calif.	Abigail Adams House.
Mercier, Marie	Northampton	Draper Hall.

[1] Admitted on probation, entrance record incomplete.
[2] Special freshman.

Paterson, William Leslie	Sarnia, Ont., Canada	45 East Pleasant Street.
Perley, Sadie	Gardner	Abigail Adams House.
Thayer, Cecile Edith	Greenfield	Abigail Adams House.
Wiklund, Carl John	Norfolk	4 North College.

Registered after the Catalogue for 1922 was published.

CLASS OF 1926.

Gannon, William James	Arlington.
Gorriaran, Manuel	Boston.
Haworth, George Goodman	Dalton.
Nolte, Whitney Roberts	Weston.
Sheldon, Herbert Carl	Cliftondale.

Special Student.

Bartley, Mary Ann	Amherst.

GEOGRAPHICAL SUMMARY.

Massachusetts	449	Maryland	1
Connecticut	8	Minnesota	1
Maine	6	Ohio	1
New York	6	South Carolina	1
Rhode Island	5	Wisconsin	1
New Jersey	4	Canada	4
New Hampshire	5	Cuba	1
Vermont	3	Armenia	1
California	3	Asia Minor	1
Florida	2	Denmark	1
Michigan	2	India	1
Missouri	2	Russia	1
Pennsylvania	3		
Kansas	1	Total	514

SUMMARY BY CLASSES.

CLASS.	Men.	Women.	Total.
Graduate school	61	6	67
Seniors, 1924	87	7	94
Juniors, 1925	71	4	75
Sophomores, 1926	120	17	137
Freshmen, 1927	112	13	125
Specials	10	6	16
Totals	461	53	514

Short Course Enrollment.

Two-Year Graduates, 1923.

Adams, Alton Wales	Brattleboro, Vt.
Albee, Frank Smith	Lee.
Allen, Milton Clifford	North Dartmouth.
Ambrose, Earle Clifford	Amherst.
Armstrong, John Shepard	Attleboro.
Bacon, Harold Northrup	Welfare Island, N. Y.
Bangs, Walter Albert	Somerville.
Barnicle, Edward Joseph	Waltham.
Barrett, Avery Herbert	Brattleboro, Vt.
Beekman, Warren Amerman	Clover Hill, N. J.
Benson, John Melvell	Mount Desert, Me.
Blake, Roger Clarence	East Bridgewater.
Bligh, Norman Francis	West Willington, Conn.
Booth, Sarah Elizabeth	Springfield.
Breivogel, Henry Adam	Amherst.
Carlson, Carl Albert	Beverly.
Caron, Albert Francis	Orleans, Vt.
Case, Richard Scofield	Winchester.
Cox, Henry Jarus	Melrose.
Crandall, Alfred Arther	Montpelier, Vt.
Cutler, Walter Leon	Springfield, Vt.
Daw, Elwyn Hudson	Amherst.
DeNyse, Arthur William	North Amherst.
Edminister, Allen Williams	Brooklyn, N. Y.
Elliott, William James, Jr.	Brookline.
Emerson, Theodore Waldo	Chelmsford.
Fairman, Frederick Donald	Amherst.
Feeney, Charles Joseph	North Amherst.
Foster, Henry Cope	Centerville, R. I.
Galbraith, Hermon William	South Hadley.
Garrett, Wallace Frederick	Milton.
Harvey, William Moody	Waltham.
Hastings, Edward Henry	Worcester.
Haughland, Johan Richard	Somerville.
Hayward, Lester Burton	Amherst.
Henry, Carl Blaney	Westborough.
Hersome, Clyde Elwood	Lowell.
Hesse, Fred August	Hasbrouck Heights, N. J.
Hesse, Louis August	Hasbrouck Heights, N. J.
Johnson, Harold Webster	Melrose Highlands.
Kelley, Edward Bernard	South Hadley Falls.
Kelly, S. Schofield	Blackstone.
Kenison, Ralph Milton	Saugus.
Kitchell, Wilfred Harold	Winthrop.
Kleyla, Beatrice Barbara	South Deerfield.
Kruk, John Alexander	South Deerfield.
Kuppers, John Leonard	Worcester.
Legare, Ray Roosevelt	Petersham.
Legro, Chester James	Lynn.
Leitch, Fredonna	Amherst.
Luther, Bradford Wheeler	Fairhaven.
Marshall, Frederick William	Altona, N. Y.
Mattimore, James Francis	Worcester.
Maxson, Willis Henry	Berkeley, Calif.

McGrath, Matthew	Dedham.
McKenna, George Earle	Orange.
McKinstry, John Percy	Southbridge.
McNamara, Francis Joseph	Boston.
Merrifield, Ralph Addison	Athol.
Outhuse, Donald Stedman	Littleton.
Packard, Edward Albert	Dorchester.
Park, William Hamlin	Newtonville.
Perry, Udell Thurston	Santuit.
Potter, Raymond Terry	Dorchester.
Rambo, Samuel Everett	Grafton.
Rand, George Lister	Amherst.
Ravinski, Albert John	Dover.
Rawson, Floyd Stuart	East Douglas.
Richardson, Milton Carlton	West Brookfield.
Sahlin, Harry Sixten	Dorchester.
Sayles, Arthur Updike	Providence, R. I.
Schnitzer, Harold Edward	Newport, R. I.
Scribner, Harry Verne	Waltham.
Slattery, John Thomas	Hatfield.
Smith, Charles Emerson	Westfield, N. J.
Smith, William	Whitinsville.
Spengler, Robert	Springfield.
Spooner, Edward Howland	Brimfield.
Stevenson, John	Sunderland.
Stever, Clifton Baird	Yarmouth Port.
Stickney, Burton Marsh	Chester, Vt.
Sunbury, Kenneth Arthur	Lowell.
Swanson, Paul Fredolf	Chelmsford.
Swenbeck, Herman Robert	Boston.
Thomas, Leon Chessman	South Weymouth.
Trull, Benjamin Franklin	Lowell.
Tufts, William Harold	North Easton.
Unwin, Edward	Amherst.
Wales, Forrest Martin	Stoughton.
Walker, Wallace Hayward	Ashby.
Weagle, Dennis William Scot	Marlborough.
Weed, Theodore Henry	Lenox.
Wells, Alphonsus	Brighton.
Westervelt, Harold Eric	Tenafly, N. J.
Wheeler, Charles Paine	Brimfield.
Wiedenmayer, George	Glen Ridge, N. J.
Wilson, Henry James	Boston.
Woodward, Everett Brigham	Hubbardston.

Vocational Poultry Graduates, December, 1922.

O'Brien, James Laurence	Dorchester.
Putnam, Ethel Davis	Worcester.
Shulver, Arthur	Amherst.
Thibault, Arthur Joseph	Lowell.

Two-Year Course, 1923–24.

Second Year.

Adelt, Joseph Francis, Jr.	Adams	Baker Place.
Aiken, Howard William	Amherst	Nash Block.
Aldrich, James Orin	Belchertown	Belchertown.
Austin, Eunice Marie	Fall River	Abigail Adams House.
Baker, Ralph Holabird	Cambridge	60 Pleasant Street.
Beley, Robert Arsene	Newtonville	8 Beston Street.
Bisbee, John Carroll, Jr.	Moretown, Vt.	35 East Pleasant Street.
Blanchard, Lawrence Newell	Leominster	French Hall.
Blue, James Reuben	Stony Point, Va.	35 East Pleasant Street.
Booth, George Wellesley	Everett	83 Pleasant Street.
Brown, Herbert Ellsworth	North Amherst	Pine Street, North Amherst.

Bryant, Berton Davis	Lowell	Box 80, M. A. C.
Carter, William Bradley	Tewksbury	North College.
Chisholm, Roy Bedford	Wollaston	3 South Prospect Street.
Clarkson, Arnold	Reading	101 Pleasant Street.
Cole, Albert Bradley	Red Hook, N. Y.	29 Lincoln Avenue.
Conklin, Lester Martin	Patchogue, N. Y.	29 Lincoln Avenue.
Craig, Kenneth	Boston	5 Hitchcock Street.
Cromack, Elwin Baldwin	Colrain	6 Nutting Avenue.
Cutler, Samuel Austin	Boylston	M. A. C. Bungalow.
Darling, Walter	Franklin	Baker Place.
Dennen, Charles Otis	East Pepperell	Kolony Klub.
Dennison, Leon Henry	Atlantic	83 Pleasant Street.
Densmore, Theodore Calder	Natick	North College.
Doane, Robert Allen	North Brookfield	Kolony Klub.
Eastwood, Wilfred	North Adams	Kolony Klub.
Emery, Russell Louis	Needham	35 East Pleasant Street.
English, Sherman Clements	Mattapan	17 Philips Street.
Files, Arthur Dysart	Ludlow	North College.
Fitts, Harry Bucklin	Orange	7 Woodside Avenue.
Fortune, Battie Holmes	Boston	Abigail Adams House.
Frawley, Earl Alton	New Bedford	81 Pleasant Street.
Giessler, Carl Donald	Woods of Larchmont, N. Y.	81 Pleasant Street.
Glencross, John Donald	Amherst	9 Amity Street.
Goode, Frank Arthur	Milton	101 Pleasant Street.
Goodnow, Alice Marguerite	Athol	Abigail Adams House.
Haffermehl, Forrest Wendell	Newton Centre	17 Phillips Street.
Harris, George Mitchell	Lynn	Amherst Tavern.
Haskell, Dorothy Edith	Holyoke	Abigail Adams House.
Hawthorne, Peter, Jr.	Amherst	1 Shumway Street.
Haynes, Joseph Dwight	Keene, N. H.	Sunset Avenue, care of Professor Banta.
Hazard, James Joseph	Providence, R. I.	20 Woodside Avenue.
Hazen, Stanley Luther	Longmeadow	Kolony Klub.
Healey, Martin Joseph	Hubbardston	15 Hallock Street.
Higgins, Leonard Martin	Fall River	Kolony Klub.
Hillman, Nelson Bennett	Fairhaven	North College.
Hines, Oliver Clayton	Amherst	Amherst House.
Howe, Wesley Mason	Millbury	North College.
Hulbert, Jewett William	Boston	27 Fearing Street.
Jones, Charles K.	Waitsfield, Vt.	35 East Pleasant Street.
Jones, Wendell Albert	Roslindale	R. F. D. No. 3, Box 82.
Joslin, Ralph Herbert	Waitsfield, Vt.	35 East Pleasant Street.
Lacombe, Albert George	Beverly	17 Kellogg Avenue.
Lane, Maynard Wallace	Gloucester	North College.
Lauterbach, Louis Jacob	Roslindale	Kolony Klub.
Longley, Lawrence Stanley	Greene, Me.	31 North Prospect Street.
Lowe, Dwight Mansfield	Watertown	8 Allen Street.
MacFadyen, Alfred Wellington	Wellesley	20 Lessey Street.
Macuen, Harvey Andrew	Newton	R. F. D. No. 3, Box 82.
Martyn, Roland Fowler	West Suffield, Conn.	Mount Pleasant.
Merchant, Percy Albert	Gloucester	North College.
Miller, Everett Woodman	Fairhaven	84 Pleasant Street.
Norell, John	Sunderland	Sunderland.
O'Doherty, John Edward	Woburn	81 Pleasant Street.
Olsen, Harold Bailey	Pepperell	31 North Prospect Street.
Paddock, Franklin Selby	Worcester	M. A. C. Farmhouse.
Palmer, Albert Tresnon	Everett	6 Phillips Street.
Parsons, Sidney Wing	Conway	Baker Place.
Patterson, Millard James	Ipswich	Kolony Klub.
Peaslee, George Raymond	Pittsfield	Kolony Klub.
Peklaris, Spiros Antony	Boston	2 North College.
Prentiss, Arthur Palmer	Danvers	Kolony Klub.
Rooks, Roger Franklin	Allston	4 Chestnut Street.
Sahlin, Carl Evert	Somerville	3 McClure Street.
Scotland, Gordon Lionel	Saxonville	4 Nutting Avenue.
Smith, William John	Charlestown	35 East Pleasant Street.

Solomon, Maurice	Melrose	French Hall.
Springer, Harry Brooke	North Amherst	North Amherst.
Stevens, Glenn William	Ward Hill	North College.
Stover, Walter Edward	Wellesley Hills	Kolony Klub.
Thompson, George Howard	Worcester	Belchertown Road.
Tobin, Michael Francis	Adams	Kolony Klub.
Tucker, Clarence Murray	Waitsfield, Vt.	35 East Pleasant Street.
Turffs, Clarence Joseph	Worcester	6 Phillips Street.
Walker, Franklin Perry	Westborough	6 Nutting Avenue.
Webster, Phyllis M.	Cambridge	Abigail Adams House.
White, Laurence Schaffner	Dover	Stockbridge Hall.
White, Newell Dudley	Bristol, Conn.	Pelham Road.
Wydeen, Albert Ferdinand	Amherst	R. F. D. No. 1.

First Year.

Ackerman, Randolph Spofford	Salisbury	13 Phillips Street.
Ansell, Harold King	Grantwood, N. J.	9 Fearing Street.
Arnold, Elliott Frank	Woburn	27 Fearing Street.
Baker, Willis A.	Winchester	23 East Pleasant Street.
Berry, Harold Edward	West Natick	108 Pleasant Street.
Blais, Lester Theodore	Holyoke	9 Fearing Street.
Breckenridge, Earl	Lawrence	7 Nutting Avenue.
Brownell, Abbott Francis	New York, N. Y.	17 Phillips Street.
Buswell, Albert Henry	Somerville	3 Fearing Street.
Carter, Carlton Maguire	South Essex	101 Pleasant Street.
Cepurneek, Andrew John	Wrentham	101 Pleasant Street.
Chaffee, Curtis Walter	Burlington, Vt.	40 Amity Street.
Chilson, Dorothy Lila	Huntington	Abigail Adams House.
Cooper, Janice Marie	Westfield	18 Sunset Avenue.
Crooks, Donald Lovell	North Brookfield	15 Hallock Street.
Crooks, Harold Baker	North Brookfield	15 Hallock Street.
Cummings, Frank James	North Adams	101 Pleasant Street.
Dennett, James Winslow	Plympton	101 Pleasant Street.
Densmore, Miles Winthrop	Natick	101 Pleasant Street.
Derby Benjamin Edward	Concord Junction	17 Kellogg Avenue.
Dow, Frederick Adams	Melrose	Fearing Street.
Flexer, Carl Seler	Allentown, Pa.	The Davenport.
Fredrickson, Gunnar Knute	Brockton	116 Pleasant Street.
Friedli, George Edward	Yonkers, N. Y.	7 Nutting Avenue.
Frieh, George Joseph	Jamaica Plain	66 Pleasant Street.
Fuller, Douglas William	Southampton, L. I., N. Y.	7 Nutting Avenue.
Griswold, Christine Mueller	Springfield	Abigail Adams House.
Hall, Ivory Arthur	South Portland, Me.	3 Nutting Avenue.
Harrington, Donald Francis	Framingham	75 Pleasant Street.
Harrington, Douglas Waldomar	Framingham	75 Pleasant Street.
Hartney, Clyde Clarence	Athol	101 Pleasant Street.
Hayn, Ernest Morris	Springfield	17 Phillips Street.
Hill, Dorothy Rice	Rockland, Me.	Abigail Adams House.
Hubbard, George Clayton	Holyoke	25 Taylor St., Holyoke.
Johnson, Mary	Boston	Abigail Adams House.
Jordan, William D.	Somerville	3 Fearing Street.
Kalberg, Mildred May	East Cambridge	Abigail Adams House.
Kane, John Vincent	Lenox	17 Phillips Street.
Keyes, Madelon Frances	Dorchester	Abigail Adams House.
Kingsbury, Carl Manning	Woodville	Sunset Avenue.
Kyle, Gordon	Everett	70 Lincoln Avenue.
Lamont, Alton Woodbrey	Auburndale	11 South College.
Lawton, Clarence Copeland	Worcester	27 Fearing Street.
Lindgren, Lawrence Edward	Worcester	60 Pleasant Street.
Mahoney, Joseph Frederick	North Easton	70 Lincoln Avenue.
Matuleurcz, Andrew Joseph	Orange	Overlook Farm.
Mecum, Ethel Doris	Becket	Abigail Adams House.
Mellor, John Albert	West Somerville	3 McClure Street.
Merryman, Rebecca Eastman	Bradford	Abigail Adams House.
Montague, Guilford	Sunderland	83 Pleasant Street.

Moulton, Marshall T.	Ipswich	101 Pleasant Street.
Murphy, Thomas Patrick	Woburn	3 Fearing Street.
Myers, Morley Whitfield	Hingham	101 Pleasant Street.
Nutter, Richard Louis	Melrose Highlands	17 Kellogg Avenue.
Patterson, Harold Taylor	Barre	75 Pleasant Street.
Patch, Frederic Whiting	Framingham	75 Pleasant Street.
Payne, Donald Tubbs	Dunstable	101 Pleasant Street.
Perkins, Harold Kent	Melrose Highlands	5 Hitchcock Street.
Pickard, Cyrus Warren	Concord Junction	17 Kellogg Avenue.
Pomeroy, Allen Bradford	Longmeadow	9 Fearing Street.
Power, James Anthony	Arlington	4 Nutting Avenue.
Reynolds, Helen Caroline	Haverhill	Abigail Adams House.
Ross, Edward Cooper	Watertown	7 Nutting Avenue.
Safford, Nathaniel Morton	Milton	75 Pleasant Street.
Scott, Thomas John	Bristol, Conn.	Amherst Tavern.
Severance, Charles Almon	Moultonboro, N. H.	8 Allen Street.
Smith, Herman Douglas	Wellesley	17 Phillips Street.
Snodgrass, Bernard Rudolph	Toledo, O.	3 Fearing Street.
Stow, Basil Tenney	Stow	70 Lincoln Avenue.
Thayer, Richard Horton	Somerville	Mt. Pleasant, care of Mr. C. R. Green.
Thompson, Kenneth Horatio	Revere	45 Pleasant Street.
Titus, Alvin Randolph	Allston	101 Pleasant Street.
Tower, Lester Wilton	South Weymouth	Box 4, North Amherst.
Towne, Milton Curtis	Petersham	101 Pleasant Street.
Welch, John D.	Northfield, Vt.	101 Pleasant Street.
Wetherbee, Roger Frederick	Pepperell	31 North Prospect Street.
Wilson, Herbert Ralph	Everett	70 Lincoln Avenue.
Woodruff, Webster Clinton	Fitchburg	Fearing Street, care of Mrs. Nims.
Wooley, Miriam Ryder	Malden	Abigail Adams House.
Wright, Harriet Goodhue	Boston	Abigail Adams House.

Vocational Poultry Course, 1923–24.

Frasier, Richard Pope	Brockton	69 Lincoln Avenue.
Kaligian, Kenneth Mitchell	Holbrook	Eames Avenue.
Lalumiere, William A.	Haverhill	15 Fearing Street.
Seppa, Karl Ivar	Gardner	101 Pleasant Street.

Winter School, 1923.

Ahrens, Theodore	Mittineague.
Anderson, Walter S.	Southwick.
Bacon, William H.	Everett.
Baker, George L.	Amherst.
Barney, Rodman S.	North Swansea.
Barrett, Francis L.	Furnace.
Bates, Donald H.	North Amherst.
Bittman, Andrew J.	Maplewood, N. J.
Blakesley, Raymond W.	Westhampton.
Boman, Lauri	Ashburnham.
Brooks, Franklyn J.	— —
Burrington, Reginald C.	North Amherst.
Carey, Robert B.	Springfield, Vt.
Clapp, Raymond L.	Northfield.
Clark, Edward P.	Richmond.
Cook, Chester A.	Reading.
Coryell, Eliot B.	Birmingham, Mich.
Curtis, Francis S.	Chestnut Hill.
Daley, John P.	Beverly.
Diebner, Mrs. Louis J.	Amherst.
Dill, Thomas G.	Raynham Centre.
Donald, David	Pittsfield.
Egleston, Lilian	Elizabeth, N. J.
English, Edwin L.	Boston.
Fillmore, W. L.	Amherst, Nova Scotia.

Feeney, Ellen M.	Amherst.
Foss, Thelma	Auburn, Me.
Frishkopf, Michael	New York, N. Y.
Garfield, Henry G.	Saxonville.
Gates, Lucinda	Newtonville.
Gilbert, Lawrence W.	Springfield.
Godvin, Mary V.	Jamaica Plain.
Griswold, Emily K.	Greenfield.
Gustin, Francis B.	North Amherst.
Harrison, R. Clive	Longwood, Ontario, Canada.
Hasanovitz, Samuel	North Middleborough.
Haslam, Emerson F.	Westwood.
Heald, Kenneth F.	Amherst.
Hixon, Allen W.	Worcester.
Jenks, Bertha A.	Amherst.
Jenks, Jabez C.	Amherst.
Kelly, Shaun	Richmond.
Kerner, Nathan M.	Roxbury.
Kimball, John A.	Westford.
Kindsgrab, William	West Orange, N. J.
Leary, Edward J.	Tewksbury.
Liepe, Fred G.	Cologne, N. J.
Matthies, Robert A.	West Roxbury.
McLeod, Duncan F.	Marlborough.
McSweeney, Margaret	West Roxbury.
Melican, George D.	Worcester.
Miltimore, John E.	Derry, N. H.
Nelson, Fred W.	Reading.
Nielson, Malcom H.	Newton.
Orr, Harold G.	Chicopee.
Parker, Charles W.	East Orleans.
Parker, Helen M.	East Orleans.
Prendiville, Jane	Worcester.
Rambo, Mildred	Sunderland.
Rankin, Mildred	Boston, Mass.
Rautenberg, Gustave H.	Leonia, N. J.
Reardon, Louis A.	North Abington.
Reed, MacMinn N.	Brewster.
Robinson, Gordon W.	Lexington.
Roper, Harold B.	Ipswich.
Ruedlinger, Arthur J.	Minneapolis, Minn.
Scace, Charles H.	Pittsfield.
Schaefer, Edward G.	Avon, Conn.
Shaw, Glenn, D.	Bath, Ohio.
Sisson, Philip R.	Woodville, R. I.
Sleeper, Charles E.	Haverhill.
Smith, Carrie A.	West Brookfield.
Solomon, Hyman S.	Colchester, Conn.
Somes, Ronald K.	North Edgecomb, Me.
Stearns, Carleton M.	Melrose.
Steere, George M.	Southwick.
Stemmle, Joseph J.	Springfield, N. J.
Terrill, Harry	Greenfield.
Truesdell, Francis E.	Shelburne.
Unwin, Vera E.	Amherst.
Wade, Edwin S.	Leeds.
Warren, Miriam E.	Chelmsford.
Watt, Raeburn M.	Lancaster, Ontario, Canada.
Weld, Arthur B.	Wakefield.
Zeiss, Harold	Pasadena, Calif.

School for Florists, June 25–30, 1923.

Anderson, Charles A.	Easthampton.
Bollinger, Godfrey	Cromwell, Conn.
Edwards, Clarence J.	Milton.

Hunt, Lawrence E.	Rutland, Vt.
Parker, Katherine V.	South Lancaster.
Perkins, Granville N.	Westwood.
Rose, Herbert A.	Walpole.
Richardson, Jane T.	Lancaster.
Rugg, Gladys J.	Simsbury, Conn.
Townsend, Anna	Winchendon.
Ward, M. E.	Dedham.

Course for Country Clergymen, July 9–13, 1923.

Allen, George E.	Plainfield.
Anderson, William S.	Montague.
Barnes, Lincoln W.	Amherst.
Coldwell, S. A.	Shutesbury.
Dixon, Herbert	Heath.
Doggett, Allen B., Jr.	Hampton Institute, Va.
Eells, Edward	Chesterfield.
Eells, Mrs. Edward	Chesterfield.
Emrich, F. E.	Boston.
Hanna, John B.	Amherst.
Hatch, David P.	Lancaster.
Hawley, John A.	Amherst.
Hillard, Dow L.	Belchertown.
Hope, Arthur H.	Hadley.
Israel, Henry	Hastings-on-Hudson, N. Y.
Ives, Henry Goodson	Amherst.
Kerr, Archibald	South Amherst.
Lindeman, E. C.	– –
Lohmann, Hermann	Whately.
Luther, C. F.	Amherst.
Manwell, John P.	Williamsburg.
Moulton, J. W.	Worthington.
Nichols, Jesse G.	South Hadley.
Oxnard, Henry E.	Rehoboth.
Richmond, James	Otis.
Root, E. Tallmadge	Boston.
Rutledge, Lyman V.	Dorchester.
Sangree, Carl M.	Cummington.
Smith, C. E.	Prescott.
Smith, C. H.	Granby.
Struthers, A. L.	West Brookfield.
Struthers, Mrs. A. L.	West Brookfield.
Waldron, John D.	Mattapoisett.
Wightman, J. C.	Northampton.

Summer School, 1923.

Acheson, Lillian	Fall River.
Allen, Fanny G.	Hadley.
Baker, M. Barbara	Newtonville.
Bancroft, Ada N.	Winchendon.
Barnett, Mrs. Grace B.	– –
Batchelder, Stewart P.	North Reading.
Benson, Mable A.	North Amherst.
Binner, Mrs. Teresa C.	Amherst.
Bistrek, Helen M.	Northfield.
Bögholt, Carl N.	Newport, R. I.
Bolingbroke, Mrs. Isabel	Roxbury.
Brown, Elsie C.	North Amherst.
Brown, Jessie S.	Northampton.
Buchanan, Walter G.	Bernardston.
Butterworth, Mrs. T. F.	Amherst.
Canavan, Anna M.	Amherst.
Canty, Mary F.	Chicopee.
Chace, Martine H.	Fitchburg.
Chace, Lydia G.	Providence, R. I.

Chandler, Irene	West Hatfield.
Cole, Maude R.	Amherst.
Crafts, Mrs. D. C.	Northampton.
Crowley, Eileen K.	Amherst.
Dana, Minnie L.	Amherst.
Davison, Mrs. Hart	Amherst.
Donnelly, Alice M.	Fitchburg.
Drain, Mrs. Brooks	Amherst.
Duncan, Edith W.	Josephine, North Dakota.
Eaton, Nancy	Wells, Me.
Elder, Jeannette M.	Amherst.
Fairman, Myrtle B.	Amherst.
Fairman, Ruth E.	Springfield.
Fentem, Alice E.	West Chester, Pa.
Fentem, Beth	West Chester, Pa.
Fisher, Lina E.	Amherst.
Frellick, Arthur L.	Everett.
Frellick, Ralph S.	Everett.
Frost, Eleanor	Amherst.
Gallagher, Frances I.	Charlestown.
Geiger, Eleanor C.	Pepperell.
Gilbert, Chauncey M.	North Amherst.
Gilbert, Marguerite F.	North Amherst.
Govaerts, Mima H.	Holliston.
Graham, Doris M.	Amherst.
Gustin, Mrs. B. F.	North Amherst.
Harrington, Mrs. J. O.	Amherst.
Harrison, Edwin M.	Montclair, N. J.
Hassell, Harriett	Conway.
Hatch, Mary A.	Holyoke.
Hathaway, Marion H.	Warren.
Hawley, Merle E.	Amherst.
Hodgdon, Julia P.	Hannibal, Mo.
Howe, Jenabelle D.	North Amherst.
Ivers, Mary J.	Holyoke.
Jayne, Addie	Brooklyn, N. Y.
Jones, Mrs. Carleton P.	Amherst.
Julian, Mrs. A. N.	Amherst.
Kelley, Mrs. J. J.	Amherst.
Kelly, Leslie M.	Amherst.
Kingsford, Vera A.	Boston.
Knightly, Mary R.	Amherst.
Laduke, Ida	Worcester.
Leitch, Elinor W.	Amherst.
Lewis, Gwendolen	Amherst.
Lynch, Grace V.	Boston.
Macurdy, Louise B.	Watertown.
Mannix, Alice G.	Holyoke.
Martin, Lillian C.	New Bedford.
Mayo, William I.	Northampton.
McMullen, Anastasia U.	Watertown.
Meserve, Mary L.	North Amherst.
Meyette, Florence A. M.	George's Mills, N. H.
Michels, Mrs. C. A.	Amherst.
Minor, Frances	New York, N. Y.
Morse, Ruby H.	Amherst.
Murdock, Dorothy W.	Marblehead.
Newpert, Mrs. Florence E.	Amherst.
O'Brien, Katherine F.	Amherst.
O'Connor, Arthur M.	Amherst.
Oetinger, Emma M.	Boston.
O'Leary, Margaret Z.	New Bedford.
Parker, Lillian Y.	Greenland, N. H.
Pendleton, Margaret G.	Amherst.
Pierpont, Mildred	Amherst.
Pushee, Mrs. G. F.	North Amherst.

Putnam, Ethel D.	Worcester.
Quigley, Teresa B.	New Bedford.
Rand, Helen M.	Fairfield, Idaho.
Reed, James P.	Hadley.
Reed, Mrs. James P.	Hadley.
Richmond, Mrs. Mary E.	Arlington, N. J.
Rile, Mary E.	North Amherst.
Roberts, Ruth W.	Amherst.
Rowell, Eleanor E.	Amherst.
Safford, Elizabeth L.	South Hadley.
Salisbury, Mrs. Golda W.	Amherst.
Sawyer, Bessie F.	Fitchburg.
Sawyer, Louise W.	Fitchburg.
Scribner, Agnes E.	Amherst.
Serex, Bertha S.	Amherst.
Shannon, Kate L.	Jamaica Plain.
Sharpe, Charles G.	Amherst.
Shaw, Arthur E.	Walpole.
Slater, Dora E.	Dalton.
Smith, Ralph L.	Kennebunkport, Me.
Smith, Wendell F.	Needham.
Spaulding, Marion	Amherst.
Springer, Fern B.	North Amherst.
Staples, Dorothy E.	Pittsfield.
Stowe, Edmund M.	Hudson.
Sullivan, Catherine E.	Amherst.
Sullivan, Mary G.	Boston.
Sullivan, Teresa	– –
Taylor, Emily	Amherst.
Taylor, Ralph G.	Lowell.
Terry, Julia S.	Amherst.
Thurlow, Henry P.	Salisbury.
Tootill, Verona E.	Pittsfield.
Toye, Louise A.	Hampton Beach, N. H.
Twible, Alice J.	Gilbertville.
Vance, Ruth	Norwood.
Van Duzor, Charlotte E.	Franklin.
Walker, Lillian B.	Amherst.
Weiler, Grace E.	Amherst.
Welch, Alice K.	Holyoke.
Whipple, Grace M.	Amherst.
Whipple, Ellen	Amherst.

STUDENTS REGISTERED AFTER THE CATALOGUE FOR 1922–23 WAS PUBLISHED.

Two-Year Course.

Second year:

Burnett, Marston	Cambridge.
Ross, Ian Hamilton	New York, N. Y.
White, Donald Mitchell	Winthrop.

First year:

Brown, Elsie	North Amherst.
Healey, Frank Hugh	Clinton.
Rogers, John	Cambridge.
de la Torriente, Jose Elias	Cotorro, Cuba.
Zinn, Arnold Stanhope	New York, N. Y.

Vocational Poultry Course.

Doherty, Edward	Woburn.
Gay, Albert Denison	Greenfield.
Myers, William Kennedy	New Haven, Conn.
Phipps, Carleton Lawrence	Holliston.
Whitman, Kenneth Towne	Hancock.

SUMMARY OF SHORT COURSE ENROLLMENT.

	Men.	Women.	Total.
Two-year Course, second year	84	5	89
Two-year Course, first year	68	12	80
Vocational Poultry Course	4	–	4
Winter School, 1923	69	16	85
School for Florists	7	4	11
Course for Country Clergymen	32	2	34
Summer School, 1923	17	110	127
Totals	281	149	430

INDEX.

PUBLIC DOCUMENT No. 31

MASSACHUSETTS AGRICULTURAL COLLEGE

THIRTY-SIXTH ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

REPORT OF THE DIRECTOR FOR THE FISCAL YEAR ENDING NOV. 30, 1923, PUBLISHED IN ACCORDANCE WITH THE PROVISIONS OF SECTION 32 OF CHAPTER 30 OF THE GENERAL LAWS

Publication of this Document approved by the Commission on Administration and Finance

DEPARTMENT OF EDUCATION
THE COMMONWEALTH OF MASSACHUSETTS

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

Officers and Staff.

COMMITTEE.

Trustees.	Charles H. Preston, *Chairman*, Hathorne. Arthur W. Gilbert, Belmont. Arthur G. Pollard, Lowell. Harold L. Frost, Arlington. Carlton D. Richardson, West Brookfield.
	The President of the College, *ex officio*.

STATION STAFF.

Administraton.	Sidney B. Haskell, B.Sc., *Director.* Joseph B. Lindsey, Ph.D., *Vice-Director.* Fred C. Kenney, *Treasurer.* Henry S. Green, A.B., LL.D., *Librarian.* Edwin F. Gaskill, B.Sc., *Assistant to the Director.* Robert L. Coffin, *Investigator.* Mrs. Lucia G. Church, *Secretary to the Director.* Miss F. Ethel Felton, A.B., *Editorial Assistant.*
Agricultural Economics.	Alexander E. Cance, Ph.D., *Professor.* Miss Lorian P. Jefferson, M.A., *Assistant Research Professor.*
Agronomy.	Arthur B. Beaumont, Ph.D., *Professor.* John P. Jones, M.Sc., *Assistant Research Professor.*
Animal Husbandry.	—— ——, *Professor.*
Botany.	A. Vincent Osmun, M.Sc., *Professor.* Paul J. Anderson, Ph.D., *Research Professor.* Orton L. Clark, B.Sc., *Assistant Professor.* William L. Doran, M.Sc., *Assistant Research Professor.* Miss Anna M. Wallace, M.A., *Curator.* Miss Gladys I. Miner, *Stenographer.* Alyn S. Ball, *Laboratory Assistant.*
Cranberry Station.	Henry J. Franklin, Ph.D., *Research Professor in Charge.* Donald S. Lacroix, B.Sc., *Investigator.*
Dairying.	Henry F. Judkins, B.Sc., *Professor.*
Entomology.	Henry T. Fernald, Ph.D., *Professor.* Arthur I. Bourne, A.B., *Assistant Research Professor.* Harlan N. Worthley, M.Sc., *Investigator.* Miss Bridie E. O'Donnell, *Stenographer.*
Farm Management.	James A. Foord, M.Sc.Agr., *Professor.*
Horticultural Manufactures.	Walter W. Chenoweth, M.Sc., *Professor.*
Vegetable Gardening and Market Garden Field Station.	Harold F. Tompson, B.Sc., *In Charge, Market Garden Field Station.* Victor A. Tiedjens, M.Sc., *Assistant Research Professor.*
Meteorology.	John E. Ostrander, A.M., C.E., *Meteorologist.*

Microbiology. Charles E. Marshall, Ph.D., *Professor.*
Arao Itano, Ph.D., *Assistant Professor.*

Plant and Animal Chemistry. Joseph B. Lindsey, Ph.D., *Chemist.*
Edward B. Holland, Ph.D., *Research Professor.*
Fred W. Morse, M.Sc., *Research Professor.*
Carlton P. Jones, M.Sc., *Assistant Research Professor.*
John G. Archibald, B.Sc.Agr., *Assistant Research Professor.*
Charles O. Dunbar, B.Sc., *Investigator.*
Harry L. Allen, *Laboratory Assistant.*
James R. Alcock, *Assistant in Animal Nutrition.*
Miss Margaret C. Eppler, *Clerk.*

Pomology. Fred C. Sears, M.Sc., *Professor.*
Jacob K. Shaw, Ph.D., *Research Professor.*
John S. Bailey, M.Sc., *Investigator.*
Harold E. Wilson, *Laboratory Assistant.*
Miss Ethelyn Streeter, *Stenographer.*

Poultry Husbandry. John C. Graham, B.Sc., *Professor.*
Frank A. Hays, Ph.D., *Research Professor.*
Miss Ruby Sanborn, A.B., *Investigator.*
Miss Alice Twible, *Clerk.*

Rural Engineering. Christian I. Gunness, B.Sc., *Professor.*

Veterinary Science and Animal Pathology. G. Edward Gage, Ph.D., *Professor.*
Normal J. Pyle, V.M.D., *Assistant Research Professor of Avian Pathology.*

CONTROL SERVICE.

Henri D. Haskins, B.Sc., *Official Chemist, Fertilizer Control.*
Philip H. Smith, M.Sc., *Official Chemist, Feed Control.*
Lewell S. Walker, B.Sc., *Assistant Official Chemist, Fertilizer Control.*
Frank J. Kokoski, B.Sc., *Analyst, Feed and Fertilizer Control.*
—— ——, *Analyst, Fertilizer Control.*
James T. Howard, *Inspector, Feed and Fertilizer Control.*
Miss Cora B. Grover, *Stenographer, Feed and Fertilizer Control.*
Oliver S. Flint, B.Sc., *Analyst, Poultry Disease Elimination.*
Miss Hazel M. Parker, *Laboratory Assistant, Poultry Disease Elimination.*
Miss Rebecca L. Mellor, *Clerk, Poultry Disease Elimination.*

REPORT OF THE DIRECTOR.

SIDNEY B. HASKELL.

NEW WORK INSTITUTED.

The Legislature of 1923 made provision for three additions to the staff of the Experiment Station,—assistant research professors in Agronomy and in Vegetable Gardening, and an investigator at the Cranberry Station. Since funds to care for these new positions did not become available until September 1, little more could be done than to initiate the different phases of work for which these additional staff members were employed.

At the Market Garden Field Station was instituted an investigation entitled "A Study of the Factors Influencing the Heading of Greenhouse Lettuce." This project will be of service to greenhouse lettuce growers. Winter lettuce has until recently been a main crop in the greenhouse industry of the State. Competition of out-door lettuce from California has, however, been very serious, and in some cases

has caused the closing of the greenhouse for the winter season. The problem, therefore, resolves itself into an attempt to develop ways and means by which the heading of greenhouse lettuce, grown during the short days of midwinter, may be controlled. There are three main lines of attack: first, through the use of artificial light to lengthen the growing day; secondly, through control of nutrient conditions; third, through breeding lettuce suited to the abnormal conditions of deficient sunlight.

The department of Agronomy has undertaken a comprehensive study of the effect of cropping systems on the growth and development of stalk-cut tobacco. This work will take some years to complete, for despite the fact that need for this study became apparent about a quarter of a century ago, very little has been done. In developing plans for this research, the Connecticut Experiment Station has given significant assistance. It is, in fact, essential that Massachusetts and Connecticut co-ordinate their studies, for the problems in the two states are much the same.

An intensive study of onion thrips control was instituted during the year. This insect has caused serious damage to the onion industry of the Connecticut Valley. During the past two or three years it has been particularly damaging. The results of the first year's study are highly encouraging, for they have demonstrated that a certain degree of control is at least possible, even though somewhat costly.

A survey of current practice in feeding of garbage to hogs was instituted during the year and carried through to successful completion. Mr. Glatfelter of the College had charge of the work. This was most productive in showing that, on account of the varied nature of the industry, a formal study of this problem is impracticable.

On account of the change in work brought about by the retirement of Dr. Goodale and the taking over of this work by Dr. Hays, the projects in Poultry Husbandry were reformulated. The old projects are still being carried on, and in addition three new projects, respectively on "A Genetic Study of Rhode Island Red Color", "Determination of Genetic Laws Governing Results in Inbreeding of Poultry" and "The Hatchability of Eggs", all under the immediate direction of Professor Hays, have been undertaken. These are based largely on records made during the ten years over which the poultry breeding work of the Experiment Station has been continued. As time goes on the data so painstakingly collected will be increasingly valuable.

Other new work undertaken during the year includes a vegetation test to study the availability of the nitrogen in certain grades of mixed fertilizers, under the immediate direction of Mr. Haskins of the Fertilizer Control Service; and, in co-operation with the United States Department of Agriculture, a study of fruit harvesting and storage, under the immediate direction and leadership of Mr. Raleigh of the College Department of Pomology. The Department of Veterinary Science and Animal Pathology has instituted a fundamental study of bacteriophagic specificity with special reference to *B. pullorum* infection and therapeusis, with Dr. Pyle in charge.

A preliminary study of the immediate effect of fertilizer as applied in varying quantities on the germination of onion seed was carried through. Despite the fact that this work indicated occasional delay in germination through the use of large quantities of chemicals, it will not be continued in 1924. The conditions under which the work was carried on are not such as to warrant its continuation.

An indicative feeding test, without formal project organization, has been under way for some months, in testing the value of hydrolyzed sawdust for dairy stock. This work is in co-operation with the Forest Products Laboratory of the United States Department of Agriculture, and supplements work being done in other parts of the country. The indications are that sawdust treated in the way indicated has a definite food value, and that a definite project study of the problem should be undertaken.

MORE IMPORTANT RESULTS OF THE YEAR'S WORK.

Definite proof of the fact that higher food costs of Massachusetts are due to factors within the control of the State, rather than to either the geographical location of the State or the amount of agriculture in the State, was developed in the prosecution of Dr. McFall's project "Boston Food Supply Study." The whole-

sale costs of food in Massachusetts are but slightly higher than in other competing states. Over against this is the fact that the retail costs of food are from 14 to 17 per cent higher, on an average of costs in a weighted dietary, than in other competing sections. Somewhere in the costs incident to the handling, sale and distribution of food within the State are costs apparently not incurred in the same degree in other sections. This, however, must be considered as merely the starting point for further investigation.

There has been continued progress in the nursery certification work, organized under the Massachusetts Fruit Growers' Association, and based on Dr. Shaw's study, "Tree Characters of Fruit Varieties." About 65,000 nursery trees were certified. This work is not properly experimental, despite the fact that it is a charge against research funds. The only apparent way in which the research studies thus far made can be used to good advantage is in continuing the work until men and organizations can be trained to give service in certification of varieties. Sufficient progress should be made by another season to permit of the Station withdrawing from this commercial service phase of the investigation.

From the Market Garden Field Station as well as from other experiments in Amherst, have come some rather striking contributions to the ever-present problem of fertility maintenance. At both places there have been certain areas of land which have been maltreated over a period of years; in the one case for more than a generation, in the other since the Field Station was first started in 1918. The significant fact developed is that, even when the producing power of the soil drops to a low level through neglect or maltreatment, injury is not permanent. At the Market Garden Field Station areas of land unfertilized for five years, but this last year receiving a heavy application of chemical fertilizers, gave crops nearly as good as those receiving normal treatment. At the home station, the depressing effect of past one-sided fertility treatment was overcome in a single season by what may be called a normal optimum application of manures and fertilizers.

The work carried on in the eastern part of the State during the past three seasons on the control of apple scab has been brought to a successful and satisfactory conclusion. Professor Webster S. Krout was originally in charge of this investigation, more lately his successor Professor William S. Doran. The co-operation extended to the Station by the Nashua Fruit Growers' Association, and by the Farm Bureaus of Worcester and Middlesex Counties was extremely gratifying. The same may be said of the co-operation of those individual fruit growers who placed their orchards at the disposal of the Experiment Station for spraying investigations, and who in other ways co-operated to make the work successful. As a result of this effort, the fact that the destructive apple scab may be controlled, and at an expense but slightly greater than that ordinarily incurred without such control has been convincingly demonstrated.

Another interesting and valuable piece of work which has yielded concrete results is that carried on by Mr. Worthley in his study of the control of the squash vine borer. For years this insect has served to decrease local interest in the production of squashes and to increase the cost of this vegetable regardless of where it was produced. The only methods of control suggested were unsatisfactory, and exceedingly expensive. By the new method the egg of this insect is killed, whereas most previous methods of attack had attempted to kill after the larva had worked its way into the stem of the plant and commenced its destructive attack.

The work in the breeding of poultry as established first by Dr. Goodale and carried on more recently by his successor, Dr. Hays, continues to bring striking and most important results. The building of a house for laying hens enables the Station to project its work to a later age period than was formerly possible. In this and many other ways the project promises even greater service in the future than has been given in the past.

The investigation of the natural vegetation on permanent pastures, as conducted on the Tillson Farm, has given most valuable data. These permanent pastures should be the backbone of the Massachusetts dairy industry. So depleted have they become, however, during the years of continuous pasturage, and so foul

with weeds of many different kinds, that many are now liabilities rather than assets. On the Tillson Farm pasture, however, on land not plowed for a generation, perhaps never, the natural vegetation of running cinquefoil, hairy cap moss and other weeds has been absolutely replaced by a perfect carpet of white clover, without plowing or reseeding. The application of these results to pastures in different parts of the State is still an open question. This work, coupled with demonstrational work carried on over a period of several years by the department of Agronomy of the Extension Service, gives a starting point for the improvement of such of our permanent pastures as have not already degenerated into brush lots or open woodlands.

The year's work on onion diseases, carried on under the leadership of Dr. Anderson, concerned itself particularly with control of the onion smut through the use of formaldehyde and other products. There was striking demonstration of the value of repeated experiments. That formaldehyde properly applied prevents smut, even on badly infested land, has long been known. That under certain conditions the formaldehyde may injure germination is a comparatively recent discovery. It therefore became necessary for the Station to determine conditions under which injury from treatment might be more serious than benefit from the use of formaldehyde. The season's work showed that moisture conditions at the time of planting had a dominant effect; and that the formula of concentration and rate of application must be varied on the basis of moisture conditions in the soil at time of planting.

CAPITALIZATION OF STATION WORK.

These few scattered instances of some of the more significant results of the year's work indicate the varied ways in which the State capitalizes the agricultural research of its Experiment Station. A part goes directly to farmers and is used by them. This is particularly true of that work which develops methods of controlling injurious insects, and plant or animal diseases. In the case of the investigation of the white diarrhœa of poultry, however, it was necessary to organize a State control in order that this research work might be made of service to practical poultrymen. Again, it may be necessary to seek a commercial outlet. The plan for the certification of nursery stock is a case in point. Much of the work of the Experiment Station finds its first field of usefulness in contributing facts leading to the solution of fundamental problems of agriculture and agricultural welfare. This is particularly true of certain of the chemical and biological investigations of soil fertility, carried on the past few years, and with certain types of economic studies. With increasing separation of research and extension teaching, it is probable that greater attention must be given to the capitalization of agricultural research in those particular fields where it is found most valuable.

CHANGES IN STATION STAFF, DECEMBER 1, 1922 TO DECEMBER 1, 1923.

During the year there were five resignations from the Station service.

Mr. Raymond W. Swift, analyst in the Control Service, resigned to accept a position with the Pennsylvania State Bureau of Animal Nutrition. This change represented a distinct advance and increased opportunity for Mr. Swift. His service here had been eminently satisfactory.

Professor Webster S. Krout, assistant research professor of Botany, and in charge of apple scab investigations in the eastern part of the State, submitted his resignation April 15, 1923, to enter the Extension Service of the Pennyslvania State College. Mr. Krout first entered the service of the Experiment Station in April, 1917, and during his six years of service with the Station made an enviable reputation along research lines. He was particularly successful in organizing the co-operative work on apple scab control in the eastern part of the State. It was with great regret that his resignation was accepted.

At the end of August, Miss Mildred H. Hollis, laboratory assistant in Poultry Disease Elimination, submitted her resignation. While she had been with the Station for but a year, her work had been highly satisfactory.

Miss Doris Tower, Clerk in the department of Poultry Husbandry, resigned to accept a position in the department of Poultry Husbandry, Kansas Agricultural

College, Manhattan, Kansas. Miss Tower had been with the department for four and one-half years, and had become most efficient in its work.

On November 21, Mr. S. J. Broderick, who entered the service of the Station in January, 1923, to take the place left vacant by Mr. Swift, submitted his resignation, to enter into commercial work.

On January 31, Mr. Arthur P. French, who had been investigator in Pomology for a year and a half, left the Station service through transfer to the teaching force of the College.

The large number of resignations among the more poorly paid members of the staff indicates that in our present salary schedule the Station is not keeping pace with the growth of its men in ability and productiveness. This matter, as was pointed out in a report to the president, submitted in December, 1922, is vital to the welfare of the Station and the work which it represents, and should have definite trustee study.

Appointments to fill positions made vacant by resignations include that of Professor William L. Doran, assistant research professor of Botany, to have charge of the pathological work on fruits and vegetables in the eastern part of the State. Mr. Doran is a graduate of the College in the class of 1915, and received the degree of Master of Science in 1917. He comes to the service of the Station after making an enviable record in his chosen science at the New Hampshire Agricultural Experiment Station.

Miss Alice J. Twible was appointed clerk in Poultry Husbandry to succeed Miss Tower.

Miss Hazel M. Parker was appointed to the position of laboratory assistant in Poultry Disease Elimination left vacant by the resignation of Miss Hollis.

Mr. John S. Bailey was appointed to fill the place made vacant by the transfer of Mr. French as investigator in Pomology.

New appointments include Mr. V. A. Tiedjens, assistant research professor of Vegetable Gardening, who is assigned to the experimental work at the Market Garden Field Station; Mr. John P. Jones, assistant research professor of Agronomy, who is undertaking studies in connection with the tobacco industry of the Connecticut Valley; and Mr. Donald S. Lacroix, investigator, assigned to the Cranberry Station.

PUBLICATIONS OF THE YEAR.

Annual Report.

Thirty-fifth annual report:
- Part I. Report of the Director and other Officers.
- Part II. Detailed Report of the Experiment Station (Bulletins 207–212).
- Combined Contents and Index, Parts I and II.

Bulletins.

No. 213. Tobacco Wildfire in 1922, by P. J. Anderson and G. H. Chapman.

No. 214. Combating Apple Scab. Spraying and Dusting Experiments in 1922, by Webster S. Krout.

No. 215. Pedigree, the Basis of Selecting Breeding Males for Egg Production, by F. A. Hays and Ruby Sanborn.

No. 216. Digestion Experiments with Cattle Feeds, by J. B. Lindsey, C. L. Beals, P. H. Smith and J. G. Archibald.

No. 217. The Value of Buttermilk and Lactic Acid in Pig Feeding, by J. B. Lindsey and C. L. Beals.

No. 218. The Control of the Squash Vine Borer in Massachusetts, by Harlan N. Worthley.

Bulletins, Popular Edition.

No. 216. The Feeding Value of Some Unusual Commercial Feeds, by J. G. Archibald.

Bulletins, Control Series.

No. 23. Control of Bacillary White Diarrhœa, 1922–1923, by G. E. Gage and O. S. Flint.

No. 24. Inspection of Commercial Feedstuffs, by Philip H. Smith and Frank J. Kokoski.

No. 25. Inspection of Commercial Fertilizers, by H. D. Haskins, L. S. Walker, and S. J. Broderick.

No. 26. Inspection of Lime Products Used in Agriculture, by H. D. Haskins, L. S. Walker, and S. J. Broderick.

Meteorological Reports.

Nos. 409–420 inclusive.

Scientific Contributions.

No. 1. Inbreeding the Rhode Island Red Fowl with Special Reference to Winter Egg Production, by F. A. Hays. *In* American Naturalist, Vol. LVIII, No. 654, January–February, 1924.

No. 2. A Study in the Control of Poultry Diseases, by John W. Lentz. *In* Poultry Science, Vol. II, December–January, 1922–23.

No. 3. Tests of Low Lift Pumps, by C. I. Gunness. *In* Agricultural Engineering, Vol. 4, No. 3, March, 1923.

No. 4. An Improved Formaldehyde Tank for the Onion Drill, by P. J. Anderson and A. V. Osmun. *In* Phytopathology, Vol. XIII, No. 4, April, 1923.

No. 5. Relations between Calcium Carbonate, Certain Fertilizer Chemicals and the Soil Solution, by F. W. Morse. *In* Soil Science, Vol. XV, No. 2, February, 1923.

No. 6. Control of Lettuce Drop by the Use of Formaldehyde, by Webster S. Krout. *In* Journal of Agricultural Research, Vol. XXIII, No. 8, February 24, 1923.

No. 7. The Squash Bug in Massachusetts, by H. N. Worthley. *In* Journal of Economic Entomology, Vol. 16, No. 1, February, 1923.

No. 8. Methods of Distribution of Phosphorus Fertilizers, by S. B. Haskell. *In* Journal of the American Society of Agronomy, Vol. 15, No. 4, April, 1923.

No. 9. An Experiment in Ringing Apple Trees, by J. K. Shaw. *In* Proceedings of the American Society of Horticultural Science, 1922.

No. 10. A Study of Bearing Habit of Apple Varieties, by W. B. Mack. *In* Proceedings of the American Society of Horticultural Science, 1922.

No. 11. Determination of Fatty Acids in Butter Fat: II, by E. B. Holland *et al.* *In* Journal of Agricultural Research, Vol. XXIV, No. 5, May 5, 1923.

No. 12. Influence of the Plane of Nutrition on Susceptibility to Injury from Toxic Concentrations, by F. W. Morse. *In* Journal of the American Society of Agronomy, Vol. 15, No. 7, July, 1923.

No. 13. Physiological Study of Azotobacter Chroococcum, Beijerinckii and Vinelandii Types, by Unokichi Yamagata and Arao Itano. *In* Journal of Bacteriology, Vol. VIII, No. 6, November, 1923.

No. 14. Physiological Study of Azotobacter Chroococcum. I. Influence of Vitamine B (?) and Nucleic Acid on Azotobacter, by Arao Itano. *In* Journal of Bacteriology, Vol. VIII, No. 5, September, 1923.

No. 15. The Relation of Soil Moisture to Formaldehyde Injury of Onion Seedlings, by P. J. Anderson. *In* Phytopathology, Vol. XIII, No. 9, September, 1923.

No. 16. Determination of Sulphur Compounds in Dry Lime-Sulphur, by Carleton Parker Jones. *In* Journal of Agricultural Research, Vol. XXV, No. 7, August 18, 1923.

No. 17. Comparative Effects of Muriate and Sulfate of Potash on the Soil in a Long Continued Fertilizer Experiment, by F. W. Morse. *In* Soil Science, Vol. XVI, No. 2, August, 1923.

No. 18. Farm Ownership in Massachusetts, by Lorian P. Jefferson. *In* Journal of Farm Economics, Vol. V, No. 4, October, 1923.

No. 20. Agricultural Research in its Service to American Industry, by Sidney B. Haskell. *In* Journal of the American Society of Agronomy, Vol. 15, No. 12, December, 1923.

No. 21. Notes on the Cape Cod Brood of Periodical Cicada During 1923, by D. S. Lacroix. *In* Psyche, Vol. XXX, No. 6, December, 1923.

REPORT ON PROJECTS.

Projects Completed.

During the year ten projects were completed, as follows:

Agriculture 1. Comparison of nitrogenous fertilizers. *Assistant Professor Gaskill.*
Animal Husbandry 2. Survey of garbage feeding plants in Massachusetts. *Assistant Professor Glatfelter.*
Botany 10. Apple disease control investigations. *Assistant Professor Doran.*
Chemistry 2. Digestion experiments. *Professor Lindsey and Assistant Professor Archibald.*
Chemistry 5. Chemistry of arsenical insecticides. *Professor Holland and Mr. Dunbar.*
Chemistry 6. Lime absorption and acidity of Field A. *Professor Morse.*
Chemistry 7. Effects of sulfate and muriate of potash on the soil of Field B. *Professor Morse.*
Chemistry 12. Attempting to improve the nutritive value of grain hulls. *Professor Lindsey and Assistant Professor Archibald.*
Chemistry 18. To determine the mineral constituents of forage crops. *Professor Lindsey and Assistant Professor Archibald.*
Fertilizer Control 1. Vegetation tests to study nitrogen availability. *H. D. Haskins, Official Chemist.*

In most of the above cases final report has been made, although publication may be delayed until other related work is completed.

Projects Transferred to the Inactive List.

Owing to the inability of the Station to give adequate financial support, the following projects have been transferred to the inactive list:

Botany 5. Study of plant stimulation by formaldehyde.
Chemistry 3. Summer forage crops.
Entomology 2. Economic importance of digger wasps.
Entomology 3. Control of the onion maggot.
Microbiology 1. Microbiological investigations in milk.
Microbiology 3. Canning investigations.

Projects Discontinued.

The Station policy of submitting every project of record to critical analysis of a committee has resulted in certain projects being discontinued, because of unsatisfactory operating conditions. Variation in the soil, inability to secure adequate machinery, lack of personnel — any one of these may be a contributing cause. Based upon recommendations of committees, the following projects have been discontinued:

Agriculture 4. Methods of applying lime and quantity of application.
Agriculture 6. Top-dressing permanent grasslands.
Agriculture 8. Determination of effect of fertilizer on the germination of onion seed.
Botany 12. Potato spraying versus dusting in the control of late blight.
Market Garden Field Station 4. Variety and strain tests of tomatoes.
Market Garden Field Station 5. Growth control by means of intercropping.

Catalog of Active Projects, December 1, 1923.

PLANT NUTRITION AND SOIL FERTILITY.

Chemical Investigations.

Chemistry 14. A study of the availability of soil potash, with the object of developing a system of diagnosis for soils of the State. *Professor Morse.*

Microbiological Investigations.

Microbiology 2. Soil fertility as influenced by micro-organisms in their relation to the presence and disappearance of organic matter. *Assistant Professor Itano and Mr. Sanborn.*

Physiological Studies.

Botany 1. Optimum conditions of light for plant response. *Assistant Professor Clark.*

Market Garden Field Station 7. Study of the factors influencing the heading of greenhouse lettuce. *Assistant Professor Tiedjens.*

Pomology 1. The interrelation of stock and scion in apples. *Professor Shaw and Mr. Bailey.*

Pomology 12. Apple variety fruit spur study. *Professor Shaw, Assistant Professor Van Meter, and Assistant Professor C. P. Jones.*

Pomology 14. Winter injury of brambles. *Professor Shaw, Assistant Professor C. P. Jones, and Assistant Professor Clark.*

Soil Management and Fertilizer Tests.

Agronomy 2. Tobacco cropping system investigations. *Assistant Professor J. P. Jones and Professor Anderson.*

Agriculture 3. Residual value of excess phosphorus applications. *Assistant Professor J. P. Jones.*

Agriculture 7. An attempt to restore productive fertility to wornout and maltreated soils. *Assistant Professor Gaskill.*

Botany 13. Ecological study of pasture vegetation. *Professor Osmun and Director Haskell.*

Market Garden Field Station 1. Manure economy tests. *Professor Tompson.*

Pomology 5. Comparison of cultivation and sod mulch in a bearing orchard. *Professor Shaw.*

Pomology 6. Comparison of clover sod and grass in a sod mulch orchard. *Professor Shaw.*

Pomology 7. Test of fertilizers on a sod mulch orchard. *Professor Shaw.*

Pomology 8. Test of cover crops for apple orchards. *Professor Shaw.*

Pomology 15. Orchard fertilization. *Professor Shaw.*

Pomology 16. Tests of different amounts of nitrate of soda. *Professor Shaw and Assistant Professor Drain.*

Pomology 18. Comparison of cultivation and heavy mulching of apples and pears. *Professor Shaw.*

Pomology 19. A study of the effects of fertilizer limitations on fruit plants. *Professor Shaw.*

Pomology 20. Tests of fertilizers for pears. *Professor Shaw.*

Crop and Crop Management Studies.

Plant Introduction.

Cranberry 5. Blueberry investigations. *Professor Franklin.*

Pomology 17. Study of the cultivation of the high-bush cranberry. *Professor* Shaw.

Strain and Variety Tests.

Agriculture 5. Meadow fescue versus timothy. *Assistant Professor Gaskill.*

Agronomy 1. Investigation of the value of Hubam or annual sweet clover as compared with the biennial sweet clover. *Professor Michels.*

Pomology 2. Study of tree characters of fruit varieties. *Professor Shaw and Mr. A. P. French.*

Pomology 13. Studies of varieties of tree fruits. *Professor Shaw and Mr. Raleigh.*

Breeding and Crop Plant Improvement.

Market Garden Field Station 6. Improvement of Martha Washington asparagus. *Assistant Professor Tiedjens.*

Pomology 3. The genetic composition of peaches. *Professor Shaw and Mr. Bailey.*

Orchard Management.

Pomology 4, 9, 10. Experiments in pruning apples. *Professor Shaw.*

Harvesting and Storing.

Pomology 21. Study of fruit harvesting and storing. *Mr. Raleigh.*

CROP PROTECTION.

Insect Enemies of Vegetation.

Entomology 4. Control of the squash vine borer. *Mr. Worthley.*
Entomology 5. Control of the squash bug. *Mr. Worthley.*
Entomology 7. Study of insect outbreaks in various localities. *Professor Fernald.*
Entomology 8. Pest limits in Massachusetts. *Professor Fernald.*
Entomology 9. Number of generations of codling moth in Massachusetts as related to advisability of spraying for the second generation. *Assistant Professor Bourne.*
Entomology 10. Hatching dates of scale insects. *Assistant Professor Bourne.*
Entomology 17. Control of onion thrips. *Assistant Professor Bourne.*
Cranberry 1. Injurious and beneficial insects affecting the cranberry. *Professor Franklin.*

Plant Disease Control.

Botany 3. Tobacco investigations. *Professor Osmun and Professor Anderson.*
Botany 9. Investigation of carrot blight. *Assistant Professor Doran.*
Botany 5. Experimental spraying for the control of cucumber mildew under glass. *Assistant Professor Doran.*
Botany 6. Investigation of onion diseases. *Professor Osmun and Professor Anderson.*
Botany 14. Investigation of control of tobacco wildfire. *Professor Anderson.*
Botany 16. Relation of soil character to occurrence of onion smut. *Professor Anderson.*
Cranberry 2. Cranberry disease work. *Professor Franklin.*

Spray Materials — Their Nature and Use.

Chemistry 20. A study of the fundamental factors affecting the suspension adhesiveness, toxicity and general efficiency of copper fungicides. *Professor Holland and Mr. Dunbar.*
Entomology 12. Determination of best strength of lime-sulfur. *Assistant Professor Bourne.*
Entomology 13. Study of the possible injurious effects of Scalecide on trees. *Assistant Professor Bourne.*
Entomology 14. Does spraying orchards kill bees? *Professor Fernald.*
Entomology 15. Determination of the efficiency of nicotine sulfate dusts. *Assistant Professor Bourne.*
Entomology 16. Investigation of materials which promise value in insect control. *Assistant Professor Bourne.*
Pomology 11. Test of spray materials that have become commercially important. *Professor Sears and Mr. Raleigh.*

ANIMAL HUSBANDRY.

Animal Nutrition.

Chemistry 17. Attempting to secure a substitute for milk in the growing of young calves. *Professor Lindsey and Assistant Professor Archibald.*
Chemistry 19. The value of inorganic calcium phosphate in the promotion of growth and milk production. *Professor Lindsey and Assistant Professor Archibald.*

Miscellaneous.

Chemistry 4. Record of the station herd. *Professor Lindsey.*

Poultry Husbandry.

Studies in Heredity.

Poultry 1. Broodiness in poultry. *Professor Hays.*
Poultry 2. Breeding poultry for egg production. *Professor Hays.*
Poultry 3. A genetic study of Rhode Island Red color. *Professor Hays.*
Poultry 4. Determination of genetic laws governing results in inbreeding of poultry. *Professor Hays.*
Poultry 5. The hatchability of eggs. *Professor Hays.*

Poultry Diseases.

Veterinary Science 5. Bacteriophagic specificity with special reference to *B. pullorum* infection and therapeusis. *Assistant Professor Pyle.*

Agricultural Economics.

Agricultural Economics 1. Local balance of trade in farm crops. *Assistant Professor Jefferson.*
Agricultural Economics 2. Methods and cost of distribution of onions. *Assistant Professor Jefferson.*
Agricultural Economics 7. Boston food supply study. *Professor McFall.*

Meteorological Studies.

Entomology 11. Study of area of the late frosts as shown by insect distribution. *Professor Fernald.*
Cranberry 3. Weather observations with reference to frost prediction. *Professor Franklin.*

CONTROL AND REGULATIVE SERVICE.

In addition to the conduct of agricultural research, the Station administers the State feed and fertilizer control laws, the law for the inspection of dairy glassware, and the poultry disease elimination law; and likewise, in co-operation with the different breed associations, conducts tests for advanced registry. With the single exception of the law relating to the elimination of certain poultry diseases, all of these control functions are self-supporting, are administered by separate staffs, and do not represent a drain on the research funds of the Experiment Station. Full report of the poultry disease elimination work is contained in Control Bulletin No. 23, published in September, 1923. The report on commercial feedstuffs is listed as Control Bulletin No. 24; that on fertilizers as Nos. 25 and 26, the last referring to lime products used in agriculture. In addition these different departments perform a large amount of analytical service for the Experiment Station as well as for certain agricultural organizations and others. Wherever service of this kind is for other than public or community benefit, a fee is charged.

In furtherance of the dairy law, so-called, 81 certificates of proficiency have been awarded, and inspections of apparatus and machinery made in 106 different places. Two machines were condemned and minor repairs ordered on 17. Reinspections were necessary in 6 places. Six thousand, one hundred and twenty-five pieces of glassware were calibrated, of which only 18 were condemned. The very low ratio of pieces of apparatus condemned to the total inspected demonstrates most strikingly the value of a control of this kind. In the first year of full operation under this law, 291 pieces of glassware, 5.77 per cent of the whole number inspected, were condemned.

The report on the advanced registry testing of dairy cows follows:

Summary of Two-Day Test Work, December, 1922, through November, 1923.

Number of Cows tested.

Month.	Number of Supervisors, Whole or Part Time.	Guernsey.	Jersey.	Ayrshire.	Shorthorn.	Holstein.	Totals.
December	12	200	111	96	12	119	538
January	12	215	105	94	13	53	480
February	12	206	113	91	15	74	499
March	12	228	123	99	16	93	559
April	15	217	113	84	16	99	529
May	11	218	86	83	18	103	508
June	10	235	101	88	23	95	542
July	10	236	92	89	24	99	540
August	10	237	99	91	24	90	541
September	10	241	84	76	20	90	511
October	9	226	87	66	25	99	503
November	9	235	91	70	23	101	520
Totals	–	2,694	1,205	1,027	229	1,115	6,270

Number of Herds visited.

Month.	Number of Supervisors, Whole or Part Time.	Guernsey.	Jersey.	Ayrshire.	Shorthorn.	Holstein.	Totals.
December	12	34	12	12	2	13	73
January	12	36	12	11	2	10	71
February	12	36	13	11	2	10	72
March	12	41	15	12	2	10	80
April	15	40	17	10	2	9	78
May	11	44	20	9	2	13	88
June	10	37	20	9	2	10	78
July	10	33	16	9	2	11	71
August	10	37	15	10	2	10	74
September	10	31	13	7	2	10	63
October	9	33	13	8	2	11	67
November	9	37	13	7	2	11	70
Totals	–	–	–	–	–	–	885

The total number of tests made during the year ending December 1, 1923, decreased by 1,172, compared with the previous year.

There were twenty men employed for the seven-day Holstein work, 38 farms visited, and 125 reports turned in.

DIAGNOSTIC AND ANALYTICAL SERVICE.

In addition to the service already reported the Station performs a large amount of diagnostic and analytical work. The department of Veterinary Science examines samples of diseased poultry sent in for examination, makes diagnosis and reports back to the sender. The department of Botany makes similar examinations of diseased plants submitted, and the department of Entomology diagnoses insect injury from such samples of either plant or insect as may be sent in. This work is all of it most important. It is not duplicated by any other agency in the State, and requires a very high degree of skill in its performance. It must be admitted, however, that it is a heavy drain on research funds, and that the same work must be repeated annually for different individuals or communities over a period of many seasons. For this reason the work would be more efficient if it could be organized under the Extension Service.

In the department of Plant and Animal Chemistry, many analyses are made of milks, creams, feedstuffs and other products submitted for examination. This work differs from the foregoing in that more is for the benefit of the individual and less for that of the State or a group of citizens within the State. For this reason a fee is charged for certain parts of this work. The same department has given most valuable service in co-operating with other Station departments through making analyses of soils, fertilizers, feeds, plants, insecticides and fungicides and other materials on which information was needed. The co-operative spirit in which this work has been done is most gratifying.

METEOROLOGICAL OBSERVATIONS.

Department of Meteorology.

PROF. J. E. OSTRANDER, HEAD.

Annual Summary for 1923.

Pressure (in Inches).

Maximum reduced to freezing	30.52, Jan. 22nd, 11 A.
Minimum reduced to freezing	28.98, Dec. 28th, 12 M.
Maximum reduced to freezing and sea-level	30.84, Jan. 22nd, 11 A.
Minimum reduced to freezing and sea-level	29.29, Dec. 28th, 12 M.
Mean semi-daily reduced to freezing and sea-level	30.020
Annual range	1.55

Air Temperature (in Degrees Fahr.).[1]

Highest	97.0, June 19th, 3 P.
Lowest	—12.0, Jan. 31st, 6 A.
Mean hourly	46.6
Mean of means of max. and min.	46.8
Mean sensible (wet bulb)	41.4
Annual range	109.0
Highest mean daily	81.7, June 20th
Lowest mean daily	3.8, Feb. 18
Mean maximum	58.5
Mean minimum	35.1
Mean daily range	23.4
Greatest daily range	49.0, Sept. 23d
Least daily range	3.5, Nov. 7th

Humidity.

Mean dew point	36.9
Mean force of vapor	.369
Mean relative humidity	75.5

Wind.

Prevailing direction	West, Northwest

Summary.

North	12 per cent
North Northwest	11 per cent
South	12 per cent
South Southwest	12 per cent
Northwest	12 per cent
Other directions	41 per cent
Total movement	48, 864 m.
Greatest daily movement	405 m., Mar. 5th
Least daily movement	18 m., Nov. 16th
Mean daily movement	134 m.
Mean hourly velocity	5.6 m.

Maximum pressure per square foot, 22.5 lbs., = 67 m. per hour, Apr. 29th, 1 A., S. S. W.

Maximum velocity for 5 minutes, 36 m. per hour, Mar. 28th, 2 P., W. N. W.; Apr. 29th, 1 A., S. S. W.

Precipitation (in Inches).

Total precipitation, rain or melted snow	39.49
Snow total in inches	63.7
Number of days on which .01 or more rain or melted snow fell	125

Weather.

Mean cloudiness observed	45 per cent
Total cloudiness recorded by Sun Thermometer	1,686 hrs.=38 per cent
Number of clear days	141
Number of fair days	131
Number of cloudy days	93

Bright Sunshine.

Number of hours recorded	2,773 hrs.=62 per cent

Dates of Frosts.

Last	May 24th
First	Sept. 15th

Dates of Snow.

Last	April 15th
First	Nov. 8th
Total days of sleighing	86

Gales of 50 or More Miles Per Hour.

54 m. Feb. 3d, N. W.; 52 m. Mar. 19th, W. N. W.; 59 m. Mar. 28th, W. N. W.; 52 m. Apr. 24th, N.; 67 m. Apr. 29th, S. S. W.

[1] Temperature in ground shelter.

REPORT OF THE TREASURER.

FRED C. KENNEY.

United States Appropriations, 1922-23.

Dr.	Hatch Fund.	Adams Fund.
To receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1923, under Acts of Congress approved March 2, 1887 and March 16, 1906	$15,000 00	$15,000 00

Cr.

		Hatch Fund	Adams Fund
Adams:			
By salaries	$14,631 00		
tools and machinery, furniture and fixtures	20 25		
scientific apparatus	10 57		
seeds, plants and sundry supplies	5 95		
chemical and laboratory supplies	21 92		
labor	310 31		
	$15,000 00		$15,000 00
Hatch:			
By salaries	$12,980 00		
labor	1,442 13		
seeds, plants and sundry supplies	35 34		
livestock	35 00		
tools and machinery	52 25		
fertilizer	321 97		
chemical and laboratory supplies	133 31		
	$15,000 00	$15,000 00	

State Appropriations, 1922–23.

Cash balance brought forward from last fiscal year	–
Cash received from State Treasurer	$107,410 38
fees	37,522 41
sales	3,983 10
miscellaneous	424 39
	$149,340 28
Cash paid for salaries	$64,462 44
labor	15,962 03
publications	3,198 65
postage and stationery	2,375 96
freight and express	864 95
heat, light, water and power	1,105 72
chemicals and laboratory supplies	3,472 53
seeds, plants and sundry supplies	936 62
fertilizers	781 09
feeding stuffs	1,837 55
library	1,193 57
tools, machinery and appliances	2,224 75
furniture and fixtures	419 40
scientific apparatus and specimens	761 27
live stock	21 45
traveling expenses	5,398 47
contingent expenses	65 00
buildings and land	2,328 93
remitted to State Treasurer	41,929 90
Total	$149,340 28

MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION

BULLETIN No. 213 JANUARY, 1923

TOBACCO WILDFIRE IN 1922

By P. J. ANDERSON and G. H. CHAPMAN

Wildfire continues to be the most destructive disease of tobacco in the Connecticut Valley. Experiments for the purpose of perfecting the old methods or finding new methods of checking the disease are in progress.

Results of the 1922 experiments and observations on control are summarized in this bulletin. The value of sterilization of seed, soil, sash and sideboards, spraying and dusting of plants in the bed and in the field, destruction of diseased areas in the beds, roguing of plants and removal of diseased leaves from the field are discussed and directions given for the application of these measures. This bulletin also discusses the overwintering of the wildfire bacteria and their dissemination during the summer.

Requests for Bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION
AMHERST, MASS.

Publication of this Document
approved by the
Commission on Administration and Finance.

CONTENTS

BULLETIN No. 213.

DEPARTMENT OF BOTANY.

TOBACCO WILDFIRE IN 1922.[1]

BY P. J. ANDERSON AND G. H. CHAPMAN.

INTRODUCTION.

Wildfire in the Connecticut Valley.

Wildfire continues to be the most serious menace to the tobacco-growing industry of the Connecticut Valley. The season of 1922 was not less disastrous than that of 1921.

Beginning with the first recorded infection on May 7, fresh reports of infected seed-beds came in from every side with increasing frequency until it was estimated that 30 per cent of the beds of the valley contained some wildfire. No tobacco-growing town in Connecticut or Massachusetts escaped. Continuous rains and cloudy weather during the seed-bed period furnished ideal conditions for the spread of the disease and at the same time made it difficult to apply remedial measures. The same weather conditions continued throughout the setting period of June, and it was not surprising that the disease appeared in the fields almost as soon as the plants were established. It continued to spread there until, by the 4th of July, wildfire was raging in half the fields of the valley. The Broadleaf section was much more seriously affected than in 1921, while, on the other hand, many of the growers of other varieties escaped with less trouble than during the previous year. Growers were discouraged both by the wildfire and by the poor growth of the tobacco during this unfavorable weather, and some of them even plowed up their fields. But after the first week in July the weather cleared, there were no more long-continued rains, and such rains as occurred were followed by hot, clear weather. During the next three or four weeks wildfire spread hardly at all and the tobacco grew rapidly, covering the diseased leaves with healthy ones until many growers felt that the disease had passed. Rainstorms, however, became more frequent during the last few days of July and were accompanied by increased spread of disease throughout the topping period and, with but

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[1] A report of co-operative work carried on by the Massachusetts Agricultural Experiment Station and the Tobacco Experiment Station of the Connecticut Agricultural Experiment Station. Published, with a different introduction, as Bulletin 2 of the latter station.

slight interruptions, until the crop was harvested. Many of the growers who had a slight foot-leaf infection profited by their experience of 1921 and did not wait for the tobacco to ripen, but cut it "on the green side" and in this way reduced the damage somewhat. It is probably no exaggeration to say that 90 per cent of the tobacco fields of the valley were more or less affected. Some fields were so badly "fired" that not a clean plant could be found, and the price received for the crop will be but a fraction of the cost of growing.

Wildfire in Other Sections.

During the summer one of the writers had occasion to visit the tobacco regions of New Hampshire and Vermont, where conditions were found to be very similar to those which prevailed in Massachusetts.

A serious outbreak occurred in Wisconsin (Pl. Dis. Bul. 6: 40, 139), from which State the disease had not been reported previously from farms. It was also reported for the first time from New York and Georgia (Pl. Dis. Bul. 6: 62, 63). It occurred with more or less severity in Pennsylvania, Maryland, Kentucky (Pl. Dis. Bul. 6:21) and Ohio. It is rather surprising to find that in North Carolina and Virginia, in which States the disease was first found and where it was very destructive five years ago, there has been no damage from wildfire during 1922. Under date of August 19, Dr. F. D. Fromme, plant pathologist of the Virginia Agricultural Experiment Station, wrote: "We have yet to see a case of wildfire in the 1922 crop in Virginia. We have inspected well over 100 fields in counties where it has occurred in the past year. Plant beds were equally free from it this year." Under date of August 21, Dr. F. A. Wolf, plant pathologist of the North Carolina Agricultural Experiment Station, wrote: " I have not received this season a single authentic specimen of tobacco wildfire from this State."

Previous to this year wildfire was not known to occur outside the United States. It has now been reported from South Africa (2:366–368).[1]

Progress in Investigations.

Investigations with the object of developing some method or methods of preventing loss from wildfire, begun in 1921, were continued by the writers in 1922.[2] Although such methods have not been perfected as yet, nevertheless some improvements have been made on the methods previously recommended, and by another season of work we have been able to confirm more fully some measures which were recommended, while others have been found to be of less importance. Some further studies have

[1] The first number in the parenthesis refers to the bibliography on page 27 of this bulletin, and the numbers after the colon refer to pages of these publications.

[2] Results of the investigations of 1921 are recorded in Bulletin 203 of the Massachusetts Agricultural Experiment Station. Subsequent to the publication of that bulletin, Chapman has been located at the Connecticut Tobacco Substation in Windsor, but the work has been continued in co-operation between that station and the Massachusetts Agricultural Experiment Station. Valuable contributions to our knowledge of wildfire have been made by Clinton and McCormick in Connecticut, and published during the last year as Bulletin 239 of the Connecticut Agricultural Experiment Station. This bulletin and a number of other important publications on wildfire which have appeared during the last year are freely quoted and referred to here in order that the grower who reads the present bulletin may have the advantage of all that has been learned concerning this problem.

been made in regard to the life history of the causal organism, especially with reference to overwintering and dissemination. The results of the life history and control work of 1922 are briefly presented in the present bulletin.

Valuable assistance in the work has been rendered by Prof. A. V. Osmun of the Massachusetts Experiment Station and Mr. C. M. Slagg of the United States Department of Agriculture. Tobacco growers in both States, too numerous to mention here by name, have co-operated heartily with the writers in the work described in the following pages.

LIFE HISTORY STUDIES.

Overwintering of the Bacteria.

As a basis for control measures, probably no problem in regard to life history of the causal organism[1] is more important than determination of the method or methods by which the bacteria survive the winter and thus serve as starting points for wildfire of the next year. Certain experiments with the object of solving this problem were conducted during the winter of 1921–22, and though some of the results are not conclusive progress to date is reported at this time. Other experiments with the same object are now in progress, and it is hoped that they will be more satisfactory.

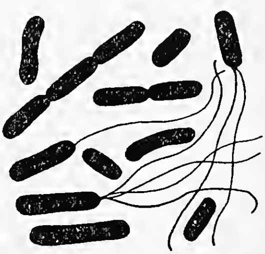

Fig. 1. — A group of the bacteria which cause wildfire. Magnified 5,000 times.

Effect of Freezing the Bacteria.

In studying the problem of overwintering, the first point to be determined is the effect which freezing has on the organisms. If they are not able to withstand the exposure of a New England winter, then the measures of control will be quite different from those which should be tried if they are resistant to cold. Pure cultures of *Bacterium tabacum* on agar were placed out of doors at various times during the winter of 1921–22, some of them being frozen solid for months; but in every case when they were brought back

[1] Wildfire is produced by the parasitic growth of enormous numbers of bacteria (*Bacterium tabacum* Wolf and Foster) in the leaves. Since various investigators who have published concerning the organism do not agree as to some of the morphological characters, Anderson during the past season has made and studied permanent slides on which the bacteria have been stained by (1) the Duckwell modification of the Pitfield method, (2) the Shunk method (Journ. Bact. 5: 181, 1920), and (3) to a less extent by other methods. The organisms are short, cylindrical rods with rounded ends and usually straight sides, but not infrequently individuals are found which are slightly curved or somewhat dumb-bell shaped. Frequently two or three of them remain end to end in a chain on the slide. Those in chains are shorter, indicating immaturity. Only those which were free from each other were used in measuring. The average size of fifty taken from five slides stained in different ways was 2.3x.8 μ. The longest one measured was 3.8 μ and the shortest 1.4 μ. Attached to one end there are one to four flagella several times as long as the body of the bacterium. The bacteria in text, Fig. 1, were drawn from a slide stained by the modified Pitfield method.

into the laboratory and transferred to other media they grew normally. The result was about what one would expect when it is remembered that few species of bacteria are killed by freezing. It is certain from data presented below that freezing does not kill them while in the leaf in the tobacco barn.

On the Seed.

It has been suspected by most workers who have investigated this disease that the bacteria may survive the winter on or with the seed, and that early infections in sterilized beds originate in this way. Although this would seem possible, there is as yet no experimental evidence to prove that such is the case in the Connecticut Valley. In Virginia, Fromme and Wingard (3) find conclusive evidence that the organism of blackfire of tobacco (*Bacterium angulatum*) overwinters in this way. Their evidence for the wildfire organism, however, is not so convincing. A number of experiments were undertaken by the writers for the purpose of determining the possibility of overwintering in this way. In the interest of brevity these experiments need not be given in detail, but the results may be summarized: —

1. All attempts to isolate the organism directly from suspected seed have failed.
2. Suspected seed has been planted and no wildfire has appeared on the seedlings where other sources of infection have been eliminated.
3. Seed inoculated by soaking in a pure culture of the bacteria and kept in a dry room all winter produced only clean plants in the spring.
4. In another experiment seed was artificially inoculated after it had been sterilized and the bacteria killed by heat. The seed remained wet from the culture for two weeks. In the spring it was sprinkled on healthy leaves and wildfire resulted, but the conditions are not the same as where seed is kept in a dry room.

All the evidence in these experiments was negative and has only the weight of such. The possibility is not precluded that there may be conditions under which the bacteria may winter directly on the seed coat.

There is no evidence that in nature a lesion may come in direct contact with the seed. No one has ever reported seeing a lesion on the seed. It is a well-known fact, however, that lesions do occur on the calyx of the flower and on the seed pod. During 1921 in Connecticut and during the late summer of 1922 in Massachusetts, pod lesions were found on plants being kept for seed. Similar lesions were also produced by artificial inoculation. In threshing out the seed small broken bits of the pods remain with the seed as chaff, and no amount of sifting and cleaning will remove every particle of chaff. If the bacteria overwinter in the seed, it is probably not directly on the seed but in these fragments of pods, etc., which are with the seed. Since it is known that they survive the winter in leaf lesions, there could hardly be any doubt that they could live over in similar lesions on the pods. Fromme and Wingard (3:20) present experimental evidence showing that the percentage of wildfire is increased by top-dressing

the seed-bed with chaff from infected pods of the previous year. It seems improbable, however, that any considerable proportion of the spring infection in the Connecticut Valley beds starts from the seed, because (1) growers now know the disease well enough so that few of them would save seed from infected plants; (2) many of the growers during the last season used old seed (grown previous to 1920) and yet they did not escape infection; (3) those who sterilized the seed were apparently no more successful in eliminating the disease from the beds than those who did not;[1] (4) even those who advocate most strongly the sterilization of seed do not present convincing data to prove that the disease organism is carried on the seed.

In the Soil.

From the plant the bacteria may get into the soil in two ways: (1) they may be washed from the plant by the rain during the growing season; and (2) when the leaves or other infected parts are turned into the soil or left to rot on the soil, the bacteria probably remain alive for a long time. It is important that we should know how long they remain alive there and capable of infection and whether they may survive the winter in this habitat.

Experiment 1. — In order to see whether the organisms could be carried from one crop to the next through the medium of naturally infested soil, such soil was taken from three beds of diseased plants at different times during the summer of 1921 and seeded with sterilized seed. The plants grown in this soil did not become infected. On the other hand, in one of the greenhouse beds which had grown a number of diseased crops, sterile seed was planted in the spring of 1922 and the seedlings became diseased before the plants were an inch high.

Experiment 2. — In this experiment one pot of soil was inoculated by spraying a suspension of bacteria over it, while another pot had an equal amount of water sprayed on it. Both were seeded shortly after sprinkling, and wildfire developed in the inoculated pot but not in the check.

During some control experiments in Whately, it was observed that even when all diseased leaves were removed from the plants, others became infected after rains and almost always on the tips which were beaten down into the soil. It appeared as though the bacteria had been washed from the diseased leaves into the soil and then splashed from the soil to other leaves.

In two fields in Hadley and North Hadley which were under constant observation by one of the writers during 1922, the plants became so badly diseased during June that all were pulled and carted from the fields. Both fields were set later with healthy plants, but in both cases there was a very heavy reinfection before the new plants were half grown. The second infection must have come by way of the soil.

Clinton and McCormick (2:404) buried wildfire leaves under healthy plants, and by this means the infection was increased to 63 per cent as compared with 13 per cent on adjacent plants not so treated.

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[1] Records were kept on the beds of 11 growers in Massachusetts who treated their seed with mercuric chloride. Wildfire afterward appeared in 5, while the other 6 had no wildfire in the beds.

The above data furnish very strong evidence that the pathogen may be carried from one plant to another or from one crop to another by means of the soil. The failure to get infection in some of the experiments by planting in infested soil shows, however, that infection will not always result necessarily because the soil was infested.

None of the experiments just quoted furnishes evidence of the length of time during which the bacteria may remain alive in the soil or indicates whether they will live through the winter in this habitat. The following experiments and observations throw some light on the latter point: —

Experiment 3. — On July 1, 1921, Erlenmeyer flasks of soil were sterilized and later inoculated with the bacteria. Part were plugged only with cotton, others were paraffined to prevent drying out. At various times during the winter, soil was taken from these flasks and plated out. Then, when bacteria developed about the particles of earth, they were shaken in a suspension of water and atomized on healthy plants. In the flasks which did not have paraffined plugs, the soil became very dry, while in the others it remained muddy. Heavy infection resulted when inoculations were made March 10 and others on March 20, 1922, from the dry flasks, but none from the tightly closed wet flasks. These flasks were kept in the laboratory and were not frozen. In this case the bacteria were still able to produce infection after eight months.

In two instances in Connecticut, wildfire was found starting in the edge of the beds in soil which had been outside the pans when the remainder of the beds were steamed. In both cases wildfire was present in the beds in 1921. The fact that the planks were new and the sash had been sterilized with formaldehyde eliminated these as the source of infection.

In a number of cases, in both States, it was found that those parts of the field which were diseased in 1921 showed the heaviest infection in 1922.

On the other hand, fields have been observed which were badly diseased in 1921 and on which tobacco was free from wildfire in 1922.

On one of the fields at the Connecticut Experiment Station the 1921 crop which was badly infected with wildfire was cut late in September and left lying on the ground over winter with a view to getting data on the overwintering under natural conditions. In this case both leaves and stalks were left to weather. In 1922 this field was planted with Havana and Broadleaf wildfire-free seedlings, the stalks and leaves of the 1921 crop having been disked and plowed under two weeks prior to setting. Throughout the season close examinations were made by Slagg and Chapman for wildfire in this field. Wildfire was not found on this particular field during the growing season, but at harvest an occasional wildfire spot was found, yet nothing to what should have developed if any considerable amount of direct infection occurred as a result of the refuse being left on the field. A careful estimate of the wildfire plants on this plot, made at harvesting, showed that infected plants were not more than one-half of 1 per cent of the total number, and on all of these the infection was light. This slight infection may have come from plants in the wildfire experimental field, since all the station plots — except for the experimental field — showed about this same percentage of infection late in the season.

Clinton and McCormick (2: 376, 419) succeeded in one experiment in infecting tobacco plants in the greenhouse by direct application of overwintered soil which had been exposed to infection the previous year. Wolf and Moss (4: 30) in North Carolina and Fromme and Wingard (3: 24) in Virginia present considerable evidence that in the South the organism winters in the soil, but we cannot accept this as conclusive proof of the same condition in New England.

Altogether the weight of laboratory data and field observations indicates that *Bacterium tabacum* is able in some cases to survive the winter in the soil and start new infection from this source in the spring. On the other hand, it is apparently possible under some conditions to raise a clean crop of tobacco on a field that has borne diseased crops during preceding years. The evidence as to soil wintering is, however, not so convincing as it should be, and further experiments are now under way which it is hoped will remedy the deficiency.

In Cured Leaves.

That the bacteria do not die when the diseased leaves are cured in the tobacco barn has been demonstrated in a number of our experiments.

Experiment 4. — On March 5, 1922, diseased cured leaves were taken from the Hampshire County warehouse just before they were ready to go into the case. They had been in the tobacco barn under normal conditions all winter. They were ground to a powder in a mortar and the powder was sprinkled on wet plants in the greenhouse. After two weeks the plants developed typical lesions of wildfire. Other leaves were ground and the experiment was repeated with the same result on March 28. On March 8 some diseased leaves were received from Mr. H. C. Wells of Deerfield. Some of them were ground and used for inoculation just as the above. Dilution plates were made from the others and the organism thus isolated used for making inoculations. Wildfire developed on the plants inoculated in both ways.

Experiment 5. — At Windsor, several times during the winter, wildfire spots from leaves kept in the station shed were brought to the laboratory and the wildfire organism isolated in pure culture. Cultures of wildfire bacteria were obtained from these leaves until the middle of March in this way, and no doubt living bacteria could have been found later than this.

These experiments were conclusive and there can now be no doubt that the wildfire organism can overwinter in cured leaves. It might get back from the cured leaves to the next year's crop in any one of a number of ways: (1) Refuse containing lesions from the shed may be thrown back to the land. (2) Sash and plank are sometimes stored in the tobacco sheds. Bits of broken diseased leaves could easily be carried out on such sash and plank and serve to start infection in the seed-bed. (3) While drawing the tobacco to the warehouse across or near the fields, parts of the diseased leaves might be scattered on the land.

Clinton and McCormick (2: 417) isolated *Bacterium tabacum* from tobacco leaves which had been dried and kept in the herbarium for periods ranging from one hundred and ninety-eight to two hundred and ninety-eight days. They were unable, however, to secure the bacteria from other leaves which had been kept for two years.

In Leaves which have been left in the Field.

Sometimes leaves when too badly diseased are picked off and thrown on the ground. At other times the whole diseased plant may be left. The suckers which grow from the old stubs after a diseased crop has been cut are usually infected. These are left on the field all winter. If the bacteria live over in these parts, they might easily start infection the following year. Being subjected to more frequent freezing and thawing and other changes of weather, it is possible that they might not survive in these leaves as they do in cured leaves in the tobacco sheds. We have very little data bearing on this point.

Experiment 6. — On April 24, 1922, diseased leaves, which had been cut down in the fall and left in the field all winter, were collected from plants at Windsor. These leaves were ground to a powder in a mortar, some of the powder was immediately applied to punctured leaves in the greenhouse at Amherst, and some of it soaked in water and the wet material applied after twenty-four hours to other plants. No infection resulted.

Similar tests were made with the same material by Chapman and Slagg, but with negative results. This negative evidence should not be considered conclusive. Further experiments are in progress.

Clinton and McCormick (2: 376, 419) succeeded in one case in infecting tobacco plants in the greenhouse with tobacco refuse which was wintered out of doors.

Occurrence of Lesions on Stalks.

Wildfire lesions have been reported previously as occurring only on the leaves and occasionally on the pods. During the inspection of a field of tobacco at South Amherst, some lesions which were suspected of being wildfire were found on the stalks. On further examination it was found that the lesions were not uncommon, but that they were present on a large part of the stalks in this field. Probably they had escaped previous notice because they are inconspicuous and somewhat different in appearance from the lesions on the leaves. They are commonly one-eighth to one-fourth inch in diameter, white, or, at most, light brown and sunken. The halo is not distinct on most of them, but can be seen about some. A number of them were brought to the laboratory and the typical bacteria isolated from them. Inoculation on leaves with these bacteria produced wildfire spots. In this same field and in various others examined through the summer, it was also observed that lesions were common on the "ears" or clasping bases of the leaves. When tobacco is stripped, these bases remain mostly on the stalk. Clinton and McCormick (2: 416) inoculated stalks and produced elongated blackened lesions. The occurrence of lesions on stalks and attached leaf bases may be important in answering the question as to whether land may become infested by throwing tobacco stalks on it. Since the organism overwinters in the leaves, there is no reason why it should not also remain alive in the stalk.

Occurrence of Lesions on Midribs.

In the process of "stemming" tobacco, the midribs are stripped from the leaf and are sold as fertilizer (incorrectly called tobacco stems). The question has frequently been raised as to whether the land may become infested by the use of "stems" from diseased tobacco. Observations as to the occurence of lesions on midribs were made at various times in fields during the summer. Frequently lesions were found running along both sides and encroaching on the midrib and often extending directly across the midrib. When the leaf was stripped from the midrib, parts of the lesion remained with the "stem." *Bacterium tabacum* was isolated directly from such denuded stems. This does not prove that the disease may be carried back to the land by using stems, since it has still to be demonstrated that the bacteria can survive the sweating process, but there can be no doubt that they occur in the midribs and may survive the winter thus in the tobacco shed. Clinton and McCormick (2: 416) produced lesions similar to those described above by inoculating the midribs with pure cultures of the bacteria.

Relation of the Condition of the Plant to Infection.

No set of experiments has been planned to determine the relation of the growth and vigor of the plant to susceptibility, but incidental to other experiments a number of observations have been made which indicate that a rapidly growing plant is much more susceptible than one which is growing slowly. During the fall of 1921 two beds were planted in the greenhouse at Amherst, — one on very poor soil and one on soil rich in rotted compost. Both were inoculated at various times and the rapidly growing plants of the fertile bed became infected, but all inoculations failed in the other bed until late in the spring, when the plants suddenly began to grow rapidly. In the course of some experiments at the Massachusetts Station during the summer of 1922 numerous unsuccessful attempts were made to inoculate a bed of very slow-growing plants which had received no fertilizer. During the same time other rapidly growing beds in the greenhouse were very readily infected. These experiments are not accurate, but certainly give some strong indications. Also the fact that infection is difficult to secure during the winter months points to the same conclusion. The relation of fertilizers to infection can probably be interpreted by their influence in producing a rapid, succulent growth or the reverse. Other investigators of the disease have made similar observations. Clinton and McCormick (2: 390) state that "the use of any fertilizer that favors rapid growth is more likely to help infection . . . than where the fertilization is such that slower or less satisfactory growth takes place." Fromme and Wingard (3: 27) express essentially the same opinion.

Dissemination.

No experiments directly dealing with dissemination were undertaken during the season of 1922, but observations throughout the year confirm the conclusions of 1921 in most respects. There is one notable exception, — the experiments and observations in 1921 led us to believe that all field infection originated from plants which were diseased when taken from the beds. The majority of the field infections, and the worst ones which we have seen in 1922, did come from that source and could be traced without any question to the seed-bed. On the other hand, a number of cases have come to the writers' attention where the beds were free from disease (if it is possible at all to tell when they are free), but disease developed in the fields set from these same beds. A few cases may be mentioned: —

1. Anderson inspected the beds of a certain Sunderland grower at intervals of three or four days throughout the season and is positive that they were free from disease. Yet parts of the fields set from these beds were very badly diseased.
2. Tobacco fields owned by a grower in South Deerfield, but located near Brattleboro, Vt., became badly diseased, and were visited by A. V. Osmun and Anderson in June. Most of these fields were set from beds near the fields, but some plants were brought from the beds in South Deerfield. A most searching examination of the beds at both places failed to reveal a single diseased plant.
3. A field of tobacco on a farm in Whately was isolated from all other tobacco fields and surrounded on all sides by woods. Plants were taken from the beds on the same farm. During the spring these beds were repeatedly inspected by C. M. Slagg, a wildfire expert, but he failed to find any infection. Yet wildfire became fairly prevalent in the isolated field.
4. The seed-beds of a grower in North Hadley were frequently inspected by Anderson during the spring, and not a trace of wildfire could be found at any time. During August some diseased plants were found in the middle of the grower's field.
5. Wildfire occurred in a field of the Massachusetts Experiment Station farm which was not being used for wildfire work, but not a trace of it had been seen in the beds at the experiment station where the plants were raised.
6. A certain Windsor grower kept his seed-beds covered at all times with copper lime dust, and frequent inspections by Chapman and Slagg showed no infection. He planted two fields, about 3 miles apart, from these beds. One of the fields developed a heavy infection during the growing season; on the other, only a trace of wildfire was found.

Many similar cases were reported by growers, but were not checked by the personal observations of the writers. The evidence is conclusive that not all field infection comes from the seed-bed. We are now confronted with the problem of determining how such infections did start. Rain could not have brought them from other fields because they were too far removed. There is some probability that in the Sunderland field the bacteria were in the soil over winter, since the worst infection occurred in the same place as last year. In the other cases, however, either no tobacco had been planted during the previous year on these fields or no wildfire had been observed there during 1921. Apparently there is some long distance disseminator which we have not yet found. Those that

suggest themselves are (1) workmen, (2) insects, and (3) wind. Since many isolated infections were discovered within a week or two after the exceptional windstorm of June 12–13, it is possible that the organisms may have been spread with the dust and sand which were blown in great clouds over the valley at that time. It has been shown above in this report that dry, infested soil dusted over healthy plants may produce infection.

All observations of the summer confirm our previous conclusion that the most important short distance disseminator of the disease in the field is the rain, especially when accompanied by wind. It should be noted here, however, that not every rainstorm is followed by a new outbreak of wildfire. It was frequently remarked, especially during July, that heavy short rains quickly followed by drying weather resulted in very little spread of the disease. The ideal conditions for spread are (1) long-continued rains, (2) rains followed by cloudy weather during which the leaves do not become dry, or (3) periods during which the rains follow each other closely. During June of 1922 we had a long-continued combination of all three of the above conditions, which resulted in the worst spread of wildfire which we have ever seen.

CONTROL MEASURES.

Sterilization of Seed.

Seed sterilization has been recommended by the writers because it was thought possible that the bacteria might be carried on or with the seed. Fromme and Wingard (3: 20) of the Virginia Experiment Station, in fact, are of the opinion that a large part of the infection is started from the seed. Although there is no conclusive evidence in the Connecticut Valley or elsewhere that such is the case, nevertheless the practice was recommended as a precautionary measure. In 1921 formaldehyde was recommended as the disinfectant (1: 75), but this year mercuric chloride was recommended because it was found to be just as efficient and was less likely to cause injury to the seed; therefore the following directions for treating tobacco seed were sent out to tobacco growers before planting time.

Purchase corrosive sublimate tablets at any drug store. Dissolve one tablet in a pint of water to make a 1/1000 solution. Use a glass jar. Place seed in a cheesecloth bag and soak in the solution for exactly fifteen minutes. Poke or stir occasionally with a stick to insure thorough wetting of all the seed. Remove bag of seed and wash thoroughly in water. Spread out seed in a warm room to dry. Store seed where it will not become contaminated. Germination of the seed will not be affected if directions are followed carefully.

Many of the growers in 1922 used the corrosive sublimate treatment for sterilizing their tobacco seed; and at the Windsor laboratory one hundred and twenty lots of seed were sterilized by this method, and the germination before and after sterilization was tested. In no instance in the laboratory tests was there any injury from such seed treatment.

Some of the growers, however, reported that they injured the seed by the corrosive sublimate treatment. Some said that germination was retarded, others that the percentage of germination was lowered; and others that the seed would not germinate at all. It was at first thought that the failure was due to faulty technique, but laboratory tests showed that even a treatment of thirty minutes was not harmful, and some of the growers omitted the washing of the seed after sterilizing without any bad effect. Some reported lack of germination in seed which was sterilized at the tobacco substation by Chapman. It was certain, then, that the injury could not be attributed to faulty technique in all cases. Inquiry among the growers as to the method by which they sprout the seed revealed one difference between their method and that used at the stations, viz., the custom which many growers have of cracking or sprouting the seed in moist cocoanut fiber or apple punk or between sods for a few days before planting. The seed is kept in a warm room of 70 to 90° F. and from time to time sufficient water is added to keep the fiber or other material slightly moist. It was thought that possibly the fiber might have something to do with the lack of germination and some of the seed was taken to the laboratory for test, using both unsterilized and sterilized seed of different lots. It was found that the unsterilized seed sprouted in the fiber and that the sterilized seed did not show any signs of sprouting even after ten days. Other growers brought in samples of seed which they themselves had sterilized and which had failed to sprout in fiber, and these lots were tested also. Chapman tried varying the conditions under which the seed was kept during the sprouting period and found that under the conditions ordinarily used it was almost impossible to sprout the sterilized seed, although the same seed in Petri dishes would germinate satisfactorily. It was found finally that in order to germinate sterilized seed, whether in punk or fiber, the pans should be kept at a lower temperature and also that the moisture content of fiber or punk must be considerably higher than usual. By close attention to these factors it was possible to sprout the different lots of sterilized seed in either punk or fiber almost as well as before sterilization.

Lack of germination of sterilized seed under usual conditions in punk or fiber appears to be due to the fact that the seed coat is hardened by the washing and drying and there is a much slower softening of the seed coat than is the case with the unsterilized seed. This was tested in the following way: —

Experiment 7. — Of two lots of seed, one was sterilized for fifteen minutes with a solution of 1/1000 corrosive sublimate, and the other treated for fifteen minutes in pure water without any chemical added. Both lots were taken from the jars and washed and dried in the usual manner. It was found to our surprise that both lots reacted the same; i.e., when placed in punk or fiber under normal conditions, the germination was greatly delayed or lacking. This experiment showed that lack of germination was not due to the corrosive sublimate treatment, but to another cause, probably the hardening of the seed coat by the washing process or possibly by the rapid drying.

The age of the seed or storage conditions may possibly play a rôle also, as in many cases growers had no difficulty with their seed. A few cases were brought to our attention where the injury was undoubtedly due to incorrect procedure in the corrosive sublimate method.

Data collected from growers who sterilized their seed during 1922 are not conclusive as to the value of the treatment for preventing wildfire.

As a result of our experience this past year, we are of the opinion that in the Connecticut Valley, seed is, at most, a minor source of infection. Nevertheless, this is a possibility which should not be lightly overlooked, and growers should not save seed from plants which show wildfire infection. If this is found necessary, however, we believe the seed should be treated with the corrosive sublimate. To avoid the difficulties discussed above, the beds should be sown with the dry seed. We do not know how long the bacteria will remain on the seed, but it is unlikely that there would be any alive on seed two or three years old. By the use of old seed the chance of infection from this source would be eliminated.

Sterilization of Soil in the Seed-bed.

Sterilization of the seed-bed soil with either steam or formaldehyde was recommended by the writers (1: 75) because it was thought possible that the organism could live from one season to the next in the soil. Considerable additional evidence that this is one of the ways in which it may pass the winter has been obtained during 1922 and presented in a previous part of this report. It is a common practice for growers to sterilize their beds to kill weed seeds, prevent root rot and for other reasons; and many beds were sterilized before the 1922 seed was sowed, a few in the fall and more in the spring. Careful records were taken on fourteen beds in Massachusetts which had been sterilized this year. Wildfire occurred in seven of them and the others remained free. No conclusion can be drawn from these data except that soil sterilization alone cannot be depended on to give a clean seed-bed. It is unquestionable that sterilization of soil by either steam or formaldehyde if properly done will kill all the wildfire bacteria in the soil treated, but it may not be so easy to eliminate the possibility of getting it contaminated again from infested soil in the walks, surrounding areas, tools, etc. These chances are perhaps greater where soil is sterilized in the autumn. Most growers use steam and consider it cheaper. If steam is used, it should be applied for thirty minutes at 100 pounds pressure. Those who do not have boilers which will produce so high a pressure may determine the proper length of exposure by burying a small potato 4 or 5 inches below the surface of the soil under the pan and applying the steam until it is cooked through. Only one of the fourteen mentioned above used formaldehyde. Formaldehyde at a dilution of $1/50$ in water is applied at the rate of one-half to three-quarters gallon to the square foot of surface. Some preferred to change the location of the beds rather than sterilize the soil. In Massachusetts accurate records were kept on eight beds, the location of which had been changed to places

where no tobacco was planted last year. Four of them had wildfire this year and four did not. The practice of sterilizing the beds should be continued not only to destroy wildfire bacteria but also to kill other disease organisms and weed seeds.

Sterilization of Sash and Plank.

The writers (1: 76) in 1921 recommended that old sash and plank be drenched with a 1/50 formaldehyde solution, and this was practiced by a number of growers. Some painted the sash and used new plank.

Data as to the benefits from this practice during 1922 are not very conclusive because in most cases other sources of introduction were not eliminated, but in a few cases under the writers' constant observation clean plants were raised in 1922 under the same sash and with the same sideboards (after sterilizing both) which had been used for badly diseased beds in 1921. Danger of infection from contaminated sash is well illustrated by the following experience of a Connecticut grower: His seed-beds in 1921 were so heavily infected in June with wildfire that the plants were destroyed. The sideboards were destroyed, the beds plowed up, and the sash stored over winter in a tobacco barn. The grower in 1922 decided to take no chances of a wildfire infection and contracted with a farmer who did not raise tobacco to grow sufficient plants for his use. The farm on which the plants were grown was remote from any tobacco fields or beds, new land was plowed and fitted, and old seed in which there was no possibility of contamination was used. It might be supposed that these precautions would insure freedom from the trouble; but as the farmer growing the plants had no sash, the sash used on the beds in 1921 were taken from the first farm and used on the beds. They were not sterilized, and shortly after the plants were up a very heavy infection occurred on all the beds on which the sash were used. While the proof is not absolutely conclusive, the inference is justified that the sash carried the bacteria. Unfortunately no beds without sash were grown in this particular instance, but it might be said that the possibility of contamination from other sources was slight indeed.

The following laboratory experiment was made with the object of determining how long the bacteria would remain alive on a piece of dry wood such as a side plank or sash: —

Experiment 8. — Small blocks of pine wood were sterilized and then soaked for eight days in a pure culture of *Bacterium tabacum* in bouillon. Then they were removed to dry, sterile tubes, where they quickly became dry and were kept so for further tests. The experiment was begun July 1, 1921, and the blocks were kept in the laboratory. At various intervals the blocks were tested for live bacteria by dropping one in sterile bouillon. They were still alive on September 10, but were dead on December 3. Sometime between these dates the last of them died. Apparently, then, they are able to live three months or more on dry wood.

In this laboratory experiment, however, the conditions are not the same as they would be in nature: (1) The wood is dried out more rapidly

by the laboratory air than by the out-of-door air where they are stored. Sash are usually stored in a tobacco shed or barn, while the planks may even be left out in the weather. The conditions in the shed are more favorable than the laboratory for the survival of the pathogen. (2) If sash are kept in the tobacco shed, it is possible for diseased parts of the hanging crop to become lodged on them. (3) If the plank are kept out of doors, the moisture conditions would be about the same as for soil. In fact, the bacteria might be alive in soil which remains attached to the plank. Since we know that the bacteria can remain alive in the leaves and in the soil over winter, there would seem to be no reason why the sash or plank would not be a source of danger. Wolf and Moss (4: 32) and Fromme and Wingard (3: 22) have presented evidence to show that the germs may be introduced into new beds by the use of old cloth covers which were previously used on infested beds. If such cloth covers or the tent covers used in previous years over wildfire crops are used, they should either be boiled thoroughly in water or soaked in formaldehyde like the sash and planks.

Spraying and Dusting Seed-beds.

Results of the first experiment on the control of tobacco wildfire by spraying or dusting the seed-bed have been published in Bulletin 203 of the Massachusetts Agricultural Experiment Station. Subsequent to the publication of that bulletin the experiment has been repeated at Amherst four times, using a greenhouse bed 4 x 16 feet for each experiment. The plants were pulled and counted when they were large enough for setting in the field, and then the bed was seeded immediately for the next experiment. The soil was not sterilized between experiments. The greenhouse bed was used in preference to an out-of-door bed because in this way a longer season could be secured and the experiment repeated more times.

Some of the fungicides used in the first experiment were omitted in later experiments because they were found to cause injury to the plants, viz., sulfur dust, lime-sulfur and the Pickering Bordeaux. NuRexo was used in the second experiment but omitted in the later ones, not because it failed to give control, but because it was thought best to confine the tests to one commercial copper spray. The copper-lime dust for the first experiment was furnished by the Riches, Piver & Co.; the dust for the later experiments by the Niagara Sprayer Company; the Pyrox was furnished for all experiments by the Bowker Insecticide Company. In order that all the data may be compared at a glance, the tables of results are first assembled and presented here all together and then followed by the general discussion.

Tests of Fungicides for the Control of Wildfire.

Description of Test.	Fungicides.	Total Number of Plants.	Diseased Plants. Number.	Diseased Plants. Per Cent.	Number of Lesions per 100 Plants.
Experiment 9: June 6 to July 26, 1921. Cloth bed, out of doors. Two applications at intervals of one week. (Bulletin 203.)	Bordeaux 4-4-50 (2 plots)	473	6	1.25	2.5
	Copper-lime dust 20-80 (2 plots)	534	3	.55	.5
	NuRexo (2 plots)	600	3	.48	.5
	Pyrox 10-50 (2 plots)	570	23	4.1	6.5
	No fungicide (4 plots)	1,079	527	48.25	178.2
Experiment 10: Oct. 10 to Dec. 10, 1921. Greenhouse. Three applications at intervals of about a week.	Bordeaux 4-4-50	848	0	0	0
	Copper-lime dust 20-80	771	3	.38	1.2
	NuRexo	747	6	.8	1.2
	Pyrox 12-40	863	5	.58	1.1
	No fungicide	1,092	221	20.2	37.5
Experiment 11: March 17 to May 10, 1922. Greenhouse. Three applications at intervals of over a week. Some infection started before first application.	Bordeaux 4-4-50	1,637	3	.2	.3
	Copper-lime dust 20-80	1,449	152 [1]	10.2	30.1
	Pyrox 12-50	1,375	140 [1]	10.0	25.8
	No fungicide	1,714	1,322	77.0	484.0
Experiment 12: May 17 to June 28, 1922. Greenhouse. Five applications at intervals of three or four days.	Bordeaux 4-4-50	1,176	2	.1	.1
	Copper-lime dust 20-80	821	0	0	0
	Pyrox 12-50	1,005	3	.3	.5
	No fungicide	883	499	57.0	208.0
Experiment 13: July 14 to Aug. 26, 1922. Greenhouse. Five applications at intervals of three to five days.	Bordeaux 4-4-50	1,205	12	1.0	1.2
	Copper-lime dust 20-80	1,056	3	.3	.4
	Pyrox 12-50	1,276	12	1.0	1.2
	No fungicide	938	860	92.0	487.0

[1] The high percentage of infection in this experiment is explained by the long intervals between applications and the fact that the bed was watered every day and inoculated twice a week.

Experiment 14. — In similar experiments at Windsor the beds were on soil which had grown a heavily infected crop of tobacco in 1921. The beds were not artificially inoculated as in the preceding experiments. The fungicides used were Sanders Dust No. 1, Niagara 20-80 copper-lime dust, Dosch 15-85 copper-lime dust, orchard brand Bordeaux lead and Bordeaux zinc. Seven applications were made at intervals of three to five days. A natural infection developed on the untreated plot and in one corner of a plot next to it. No other wildfire developed on the treated plots.

Conclusions from the Experiments and Practical Applications.

Frequency of Application. — The writers recommended in 1921 (1: 81) that the fungicide be applied once a week. Later experiments indicate, however, that this is not sufficient under the following conditions: —

1. When the plants are watered very frequently. On some soils it is necessary to water the beds heavily every day. Most of the fungicide is washed off before the end of a week. This factor was tested in Experi-

ment 11, where the plants were watered and inoculated every day or two. The percentage of infection was fairly high on the Pyrox plot and the dust plot. (The plants in the Bordeaux plot of this experiment were very small and in poor condition on account of accidental burning by cyanide gas which was used to fumigate the house. The low percentage of infection on this plot is not significant.) In the next experiment (Experiment 12) the plants were watered and inoculated less frequently and the fungicide was applied oftener. The infection was thus reduced again to less than 1 per cent.

2. When the beds are exposed to frequent rains. The first rains wash off the fungicide and later rains spread the bacteria. Even when the beds are covered during rains there is usually considerable drip through the sash between the glass.

3. When the plants are growing very rapidly, as they usually are just before setting begins. New leaves are produced so rapidly that many of them will be left unprotected for several days if the application is made only once a week.

No definite interval of time between applications can be regarded as safe. There are too many influencing factors. The only safe rule is to *keep all leaves covered at all times with the germicide.* During the very rainy season of 1922 no less than eight or ten applications would have been necessary. Growers have also found it a good practice to dust or spray the beds each time they are pulled over for setting.

Amount of Material to be applied. — In applying the dust or spray the only safe rule for judging whether enough has been applied is to note whether all leaves are covered. The amount of material required to produce a thorough covering will vary somewhat with the type of machine used and the stage of growth of the plant. In the experiments recorded above, in which a small rotary hand duster was used, it was found that no less than a pound of dust for each application was required to cover a square rod of plants when they were of a size suitable for setting. With the compressed air sprayer which was used, 1½ to 2 gallons of spray material were found to be sufficient to cover the same area.

Relative Cost of Spraying and Dusting. — At the local stores in Amherst and Windsor lime cost $4.90 per barrel of 280 pounds, or, since a little more if in smaller quantities, about 2 cents a pound, copper sulfate 11 cents a pound, Pyrox 20 cents a pound and copper-lime dust 10 cents a pound. Using the amounts per square rod which are indicated above, the cost of materials for eight applications would be as follows: —

Bordeaux 4-4-50	12 cents per square rod.
Pyrox 12-50	58 cents per square rod.
Copper-lime dust	80 cents per square rod.

Thus the cost of materials of a commercial fungicide such as Pyrox is nearly five times as great as that of the home-made Bordeaux, while the cost of the dust is nearly seven times as much. A good compressed air

sprayer can be secured on the local market for $7 to $10.50, while a suitable dust blower costs $12.50 to $18.50. The advantage which the Bordeaux mixture has in cheapness, however, is counterbalanced by the increased time and labor involved in its preparation. The copper-lime dust is immediately ready for application when received, and the Pyrox or NuRexo has only to be dissolved in water.

Dust v. Liquid Sprays. — The results of the six series of tests detailed above indicate that the percentage of control is about the same for the liquid spray as for the dust. In beds where very frequent watering is necessary, there might be some advantage in the liquid sprays, because when once dried on the leaves they adhere much better than the dust. The dust, however, has the advantage that it comes up and covers the lower side of the leaves better than the liquid. The dust can be applied more quickly, but thorough dusting with a rotary hand duster is very hard work if continued for any length of time. The dust is also irritating to the nose, eyes and throat. Cheapness of materials and machines is in favor of the liquid sprays. Altogether, the choice between liquid and dust seems to be a matter of personal taste.

Home-made v. Commercial Copper Sprays. — In the control obtained there seems to be very little difference between the results secured by the home-made preparation and the commercial sprays such as Pyrox or NuRexo. Home-made Bordeaux has the advantage of cheapness, while the commercial sprays have the advantage of more rapid preparation for application. If a grower has large beds which require frequent application, certainly it would be more satisfactory to prepare his own fungicide. For small beds the commercial sprays might be more satisfactory. Clinton and McCormick (2: 386), after experimenting with Bordeaux mixture and a number of commercial copper sprays, recommend home-made Bordeaux mixture as being cheaper and more effective than other copper fungicides. They tried dust on only one bed and had no wildfire there on either the treated or untreated plot.

Best Time of Day for Application. — Dust should be applied preferably in the early morning when the plants are wet, or after watering. When the copper sulfate and lime in the dust come in contact with water, they unite to form Bordeaux mixture, which dries on the leaf and adheres with at least a part of the tenacity of the liquid Bordeaux. If, however, the dust is applied to the dry plant and water then applied, even when the Bordeaux is formed it is mostly washed from the leaf before it dries. Liquid sprays should be applied when the plants are dry, because the spray is thus not diluted with water already on there and because less of it drips from the leaves at that time.

Absolute v. Partial Elimination of Wildfire. — It will be noted in the tables given above that in almost all of the sprayed and dusted plots a certain amount of wildfire appeared. Only in a few tests has it been possible to eliminate all infection. In the first five series of tests, however, it should be remembered that sprinkling cans full of water teeming

with the parasitic bacteria were sprinkled over all the plants every three or four days. Such a method of inoculation is much more drastic than would occur under natural conditions in the beds of the average tobacco grower. If the treatment here recommended is faithfully carried out by the grower, we believe that in the large majority of cases no wildfire will be found in his beds. Even if there are occasional infected plants in the bed, the treatment is not a failure. The removal of diseased plants from the field will be much easier if there are only a few of them. Even if they are not all removed, the amount of final infection may be expected to be less if there are only a few centers from which it can spread.

Will Clean Beds give Clean Fields? — Clean beds are not an absolute guarantee that no wildfire will appear in the fields planted from such beds. During the season of 1922 in at least six instances the writers had convinced themselves by thorough and frequent inspection that the seed-beds of certain growers were entirely free from wildfire, but the disease developed later in the fields planted from these same beds. (Read the paragraph above on "Dissemination" for more details.) Such cases, however, should not encourage any one to believe that no benefit is derived from keeping the seed-bed clean. The worst and the most widespread field infections have usually come from the bed. Starting with clean plants in the field is not the whole measure of success, but it is a long start toward it.

Success by Practical Growers. — During the season of 1922 the writers made frequent inspections and kept careful records on the seed-beds of a number of growers. Untreated checks were not left in any case, and for this reason the results are not entirely convincing. They were unable to find wildfire in any of these beds where the plants were kept constantly covered with the fungicide. On the other hand, it did appear in the beds of many who dusted or sprayed a few times, or started to treat only after the disease became evident, or used only a scant amount of material.

Value of an Arsenical in the Fungicide. — In the first test some of the fungicides, both the dry and the liquid, contained an arsenical. This arsenical not only was found to be of no value for the control of wildfire, but frequently caused injury to the plants. There seems to be no reason for adding an insecticide.

Dust Burn and Spray Injury. — Heavy application of dust or copper spray frequently causes some injury to the plants. It has been commonly noted in the experimental beds at Amherst that the plants in the check plots appear healthier (except for the wildfire) and larger than in the treated plots. Growers have frequently called the writers' attention to this condition in their beds. Sometimes it is much more marked than at other times. Frequently it cannot be observed at all. Certain conditions of the plant or its environment must be responsible for this variation, but it is not as yet known just which conditions favor and which prevent such injury.

Dust burn is evidenced on the leaves by small dead spots of one-eighth

inch diameter or less, colored white, brown or darker to black, irregular in outline, commonly bordered by indefinite blanching of the immediately surrounding tissue. This border, however, is narrow and inconspicuous and fades away indefinitely into the normal green leaf. It is quite different and easily distinguished from the halo about the wildfire spot. The leaf area about the spot is also commonly distorted or puckered into radiating wrinkles. Where excessive amounts of dust are used, whole leaves or entire plants may exhibit this wrinkled, distorted appearance without central dead spots. This results in dwarfing.

Spray injury resulting from the liquid fungicides is indicated by larger dead areas in the leaves on the margins, tips or other places where the liquid stands in drops.

Injury from either dust or liquid spray has never been serious and at most has resulted only in slightly slower growth of the plants in the beds. The plants immediately recover after being set in the field. The injury is never of sufficient importance to discourage the application of dust or liquid spray.

Secondary Benefits. — Practical growers have frequently called attention to the absence of flea beetle in the treated beds. One prominent grower has stated that he would spray whether he had wildfire or not because the beds were free from these insects. Copper-lime fungicides are known to repel flea beetles.

Frequently when the plants are thick in the bed and kept damp, they rot off at the base of the stem. It has been commonly noticed that this condition does not occur when the beds are properly treated with a fungicide.

Conclusion. — Any grower who will start when the plants are no larger than a dime and keep the leaves covered at all times with copper-lime dust or any other good copper fungicide can control wildfire in the seed-bed. We agree with Clinton and McCormick (2: 386) in the following quotation except that we would include dusting as well as spraying: —

> We are convinced that spraying of tobacco beds should be made one of the routine practices of tobacco growing as long as there is danger from wildfire. . . . We have evidence that plants thoroughly coated with the spray do not become infected anything like unsprayed plants in the same bed. Spraying to be most effective, however, must start before the appearance of wildfire and be continued until the end of the transplanting season. We would start with the young plants that have just taken root and whose largest leaves are about the size of a thumb nail. . . . *Spraying, we believe, is the only remedy that prevents spread of the wildfire in a seed-bed no matter what the source of its introduction.*

Destroying Diseased Areas in the Bed.

It is characteristic of the disease that when it is first found in the beds it does not occur uniformly over the bed, but is usually found in round spots which may be from a few inches to several feet in diameter, depending on the length of time during which the spot has been spreading. If only one or a few spots are found in a bed, it is sometimes possible

by prompt action to keep the rest of the bed clean. This may be done by immediately destroying the diseased spots by drenching them with a 1/10 formaldehyde solution. Not only the spot but all the plants within a foot or two beyond it must be killed. This treatment was successful in preventing further spread in one bed in Sunderland, in one in Hatfield and two in Windsor, all of which were under the writers' constant observation during the summer. Glass should be removed from all plants of the bed which it is desired to save, because if they are left on, the fumes of the formaldehyde will spread through the bed and burn the leaves with which they come in contact. Plants should not be hoed out or pulled out before treatment, since this only serves to spread the trouble. Plants around the burned-out areas should be watched carefully for further spread. Spraying or dusting should also be started at once if it has not been practiced previously.

Removing All Plants from a Diseased Field and resetting with Healthy Plants.

Two fields have been under the careful observation of the writers during 1922 in which this practice was adopted, but in both cases it resulted in failure. In one field in Hadley and one in North Hadley, when the plants were about a foot high, they were found to be practically all infected. All were removed from the field and after it had been harrowed the field was reset with healthy plants. In both cases before the new plants were ready to harvest, they became almost as badly infected as the old ones. Apparently the pathogen remains in the soil and under favorable conditions will infect the new crop. The grower can gain by this practice only when the weather changes for the better during the growth of the second crop. The same principle would apply also to the restocking of a field where only a part of the plants were diseased. This was tried on a large scale by a grower of shade tobacco at North Hadley, who removed only the diseased plants (about 10 per cent) and restocked with healthy plants, but failed to control the disease. The following experiment bearing on this point was tried at the Windsor station: —

Experiment 15. — In one plot nineteen diseased plants were found ten days after setting. They were all removed and replaced by healthy plants. Eleven out of the nineteen resets developed wildfire later.

During 1921 a number of growers practiced either partial or complete restocking with healthy plants after diseased ones were removed, and little or no wildfire appeared later in the field. The same was true of some Connecticut fields in 1922. This apparent control may have been due to weather conditions which were not favorable for infection of the plants of the second setting. At any rate the results were contrary to most of our experience of 1922. In view of the latter it seems questionable whether restocking should be recommended.

Roguing without Resetting.

When only a few plants in a field are diseased, it is probably best to remove them from the field and leave empty the places from which they were taken. This was tried with success by three growers in North Hadley whose fields were under the writers' observation during the present season. Other growers have told the writers that they kept wildfire in check by this method.

Experiment 16. — In a plot at the Windsor Station, where five plants were found to be diseased ten days after setting, they were all removed and the places not filled. The surrounding plants were inspected regularly and in two cases they became infected later.

In a later experiment, where the plants were about 1½ feet high, the diseased ones were removed and not replaced. Before harvesting, however, wildfire had appeared on the adjacent plants and had spread through four to six plants to the windward and along the row.

It is reasonable to believe that bacteria which came into the soil from the original diseased plant would have less opportunity for further infection if no plant replaced the diseased one which was removed. Certainly the danger of surrounding plants becoming infected is diminished by removal of infected ones from the field. On the whole, there is no question but that this practice of roguing will help to a great extent where there is only a light infection in the field, especially if the plants are pulled when small. After plants are half-grown, however, under favorable conditions the disease may spread in its customary manner, and it may be necessary to remove plants or infected leaves from plants for some distance around the original point of infection.

Picking off Diseased Leaves.

If the plants are large and infection is light, a certain amount of benefit may be derived from removing all diseased leaves and carrying them from the field. The principle of this measure is the elimination of as many as possible of the centers of spread. Then when the rains come the number of bacteria splashed to the healthy leaves will be greatly reduced. This method was tried by Anderson on a 4-acre field in Whately.

Experiment 17. — Infection in this field started from about six to eight rows near the east side, which had been planted from a diseased bed. At the time when the experiment was started a majority of the plants in these rows were diseased, and it had spread more or less to plants on adjacent rows. There was practically no infection on the west half. On June 30 all diseased leaves were picked from the east half (forty-eight rows). No attention was paid to the west half. On the badly infected rows mentioned above a large basketful of leaves was taken from each row, some of the plants being left almost without leaves. It was picked again four days later, the weather having been very rainy during the last month. Probably as many leaves were removed the second time as during the first picking. It was picked over at short intervals five times afterward, and with each picking the number of diseased leaves decreased, until on July 26 hardly a diseased leaf could be found. After the heavy rains of the last few days of July and the first of August,

however, wildfire began to appear again on the picked side of the field, but to a greater extent beyond the forty-eighth row, where no picking had been done. The field was harvested on August 8. On that date the picked and unpicked sides of the field were inspected by Mr. Arthur Hubbard, W. H. Davis, D. Potter, C. M. Slagg, Dr. James Johnson and the writer, and it was the opinion of all that the unpicked side showed much more wildfire than the picked side. Mr. Hubbard was of the opinion that the east half would not have been worth harvesting if the disease had been left to take its natural course. The loss in weight from removal of the diseased leaves was not serious. As previously mentioned in this report there was good evidence that when infection began again during the first few days of August it came from bacteria which were in the soil. This source of infection cannot be eliminated and will probably prevent this method of control from ever being entirely successful. In view of the fact, however, that the season of 1922 was usually favorable to the spread of wildfire, the results of the experiment are encouraging.

A similar experiment was conducted on a Round Tip plot at the Windsor Station and with similar results. Growers who tried picking off affected leaves are divided as to their opinion of the practical value of the method. The degree of success varied according to the kind of tobacco and method of harvesting. Chances of success are better in primed tobacco because after harvesting starts the leaves are picked so rapidly that the disease does not have an opportunity to get a good start, and it also becomes increasingly difficult for the germ-laden soil to splash to the first leaves. Field observations on the picking of leaves during 1922 lead to the following conclusion: —

On the Shade Cuban, favorable results were almost uniformly obtained and the disease was practically eliminated. On Havana and Round Tip, where diseased leaves were removed, there was a considerable variation in the results, with a majority of fields showing decided benefit. On Broadleaf there did not seem to be anything gained by picking off the leaves.

For any one who contemplates this method of control it is recommended that (1) the first inspection be made as soon as the plants are established in the field; (2) the leaves be picked off twice a week as long as any diseased ones can be found; (3) sand leaves of diseased plants be picked also.

Clinton and McCormick (2: 396) also experimented with removal of diseased leaves and as a result were somewhat doubtful as to the benefits.

Dusting the Plants in the Field.

The value of dusting the plants in the field with copper-lime dust was tried by two Massachusetts growers under the writers' supervision during the season.

Experiment 18. — Twenty-four acres in Hadley were first dusted with a four-row traction duster, which was furnished by the Niagara Sprayer Company, on July 6, when the plants were 12 to 18 inches high. The infection was bad in parts of the field when the experiment was started. Four rows were left without dust. There were very heavy rains on the 8th and the second application was made on the 13th and 18th. During July there was very little spread of wildfire in any

fields and the plants grew enormously. By the first of August the plants had grown until the machine could not be drawn through the field without serious damage to the plants, and therefore no more applications were made. There was considerable spread of the disease during August, until the crop was harvested about the middle of the month. A comparison of the treated and untreated rows at that time showed no difference in the amount of disease. No accurate counts were made, but a cursory examination while walking between the rows did not indicate any benefit from the two applications of dust. It was also noticed that there were dust-burn spots on the treated leaves similar to those which have been previously described as occurring in the beds. The owner feared that if the dusting were continued, the spots might affect the market of the crop.

Experiment 19. — Another grower in North Hadley dusted two fields with the machine used in Experiment 18, but more frequent applications were made. Wildfire was not controlled, the results being similar to those of Experiment 18.

Experiment 20. — On one of the Windsor Station plots Round Tip tobacco, which showed a heavy mixed infection of wildfire and angular leaf spot on the bottom two or three leaves when the plants were from 1 to 1½ feet in height, a copper-lime dust was twice applied to four rows, with a five-day interval between the first and second treatments, no rain falling in the interim. Six rows were left untreated for comparison. For about two weeks after treatment, the spread of the disease in the dusted rows was practically nil, while in the undusted rows it spread steadily and very rapidly. After this time three rainy days ensued, but purposely no more dusting was done. At harvest time it was found that the amount of wildfire on the dusted rows was only 15 per cent (estimated from partial count on cured tobacco) less than on the rows which had not been dusted.

No doubt, if the leaves in the field could be kept covered with dust all the time, the disease could be controlled, but this would require more frequent applications, and when the plants become large it cannot be done without considerable breaking of the leaves. Control by this method is probably possible, but not economically so. Further experiments, however, are planned. It was found that the dust adhered much better if applied early in the morning while the plants were still wet with dew.

Spraying with Bordeaux Mixture in the Field.

Bordeaux mixture was tried with the idea that it would adhere to the leaves more tenaciously and hence so many applications would not be necessary as when dust was used.

Experiment 21. — A field of 12 acres in North Sunderland was sprayed on July 11 with 4–4–50 Bordeaux. No further applications were made because the owner feared that the material would remain permanently on the leaves and affect the sale of the crop. An examination on August 14, when the crop was being harvested, showed that it was present in large enough quantity on many of the leaves to give them a decidedly blue cast. A comparison of the sprayed and unsprayed rows showed no difference in the amount of the disease.

Clinton and McCormick (2: 395) experimented with Bordeaux mixture in a preliminary way and found that it retarded spread of the disease, but they did not consider it practical because of cost and unknown effect of the spray on the quality of the mature leaf.

A few Connecticut growers tried spraying in the field in 1921 and

reported good control. This year several growers of sun as well as shade grown tobacco sprayed plants in the field from one to six times, until the plants were too large to permit of further treatment, but the results have not been encouraging in the case of sun-grown tobacco. While the treatment seemed to check the disease for a time, later in the season after the plants had grown too large to continue the treatment, wildfire spread rather rapidly, and at harvesting little difference could be observed between the sprayed and unsprayed areas in the same field. In the case of one grower who had a rather bad field infection when the plants were small, the use of a Bordeaux mixture applied twice on part of the field when the plants were small checked for a long time any further spread of the disease, and at harvesting time the part of the field sprayed twice showed much less wildfire than the unsprayed part of the field.

Bordeaux mixtures are cheaper and under field conditions remain on the leaves a longer time, which is of course desirable from the infection protection standpoint, but a disadvantage when the plants are more than half-grown, as it remains on the leaves and the blue color is undesirable after the cure.

Another factor operating against the efficiency of dusts or sprays in the field is that after the plants are about half-grown it is a practical impossibility to operate a duster or sprayer to advantage, and one is obliged to stop the treatment at what might be termed the critical period, as it is well known that there is often a heavy wildfire infection just prior to maturity.

It is believed, however, that some benefit might be obtained from dusting or spraying when the plants are small and until they are about a foot high, particularly if spraying or dusting were combined with picking off diseased leaves, and the spraying or dusting repeated at very close intervals, say two or three times a week for a period of two weeks or so.

It is believed that the application of dusts or sprays to tobacco in the field is worthy of further consideration both by the growers and the station, and next season more detailed experiments along this line will be carried on.

At present, however, the evidence at hand is not very favorable for this method of control.

THE OUTLOOK FOR 1923.

The question now most frequently asked by the grower is: What can we expect from wildfire in 1923 and in the following years? Will it continue as prevalent and troublesome as it has been in 1922? Will it become worse after our land is thoroughly infested with the germ? Or will it gradually disappear? Frequently tobacco growers have told the writers that they would stop raising tobacco if they thought the disease would continue to be as serious as it has been during 1922. No man can predict its future behavior with certainty or anything which approaches certainty, but we can base some judgment on (1) what we know about its

relation to weather conditions and (2) its behavior in States where it has been present longest.

We know that the disease can spread only when the rains are long continued or follow each other in close succession, i.e., when the water remains for long periods on the leaves. The summers of 1921 and 1922 were for the most part ideal in this respect for the spread of the disease. They have not been average summers for the Connecticut Valley. The disease will not be as destructive during an average growing season. We do not believe that wildfire will soon disappear from the valley, but during a dry summer it might not cause any damage. After a succession of unfavorable seasons the sources of infection might be so reduced that it would cause little trouble even with the return of a summer favorable for its spread. The above opinion is supported by the course which the disease has taken in the South. Five years ago it was destructive there. In 1921 the season was very dry and the injury from wildfire was slight. The season of 1922 is said to have been not unusually dry, but the disease has not returned to any extent. Our advice to the Connecticut Valley grower is to plant as usual, take a chance on the weather, but to omit no precaution recommended against wildfire.

CONDENSED RECOMMENDATIONS FOR CONTROL.

There is no one measure by the use of which a tobacco grower may be assured of raising a clean crop. As long as wildfire is in the valley, he must start before the seed is planted, be ever on the alert and ready to put into practice any part or all of the season's program which may now be briefly summarized: —

1. Select seed only from plants known to be free from the disease. If possible, go a step farther and take only from fields known to be disease-free. Protecting the flower heads with bags may be useful. Old seed is less likely to be contaminated.

2. If there is doubt about the seed being sterile, soak it in a cheesecloth bag for fifteen minutes in $1/1000$ corrosive sublimate, wash and spread out to dry.

3. If possible, locate seed-beds only on land where there was no wildfire during the previous year and where there has been no opportunity for contamination.

4. Sterilize soil with steam at 100 pounds pressure for thirty minutes, or with formaldehyde $1/50$ at the rate of one-half gallon to the square foot. It is safer to sterilize walks also. Spring sterilization is safer than fall sterilization.

5. Drench boards and sash with formaldehyde $1/50$. If cloth is used, it should either be new or should be boiled in water or treated like the boards and sash. If sash and plank are new or have never been used for tobacco beds, they need not be sterilized.

6. Keep the plants covered with copper-lime dust or a copper spray such

as Bordeaux mixture at all times, from the stage when they are as large as the finger nail until setting is completed.

7. Remember that the germs can be carried from one bed to another on the hands, tools, sash, etc., and avoid such chances.

8. Adopt a system of bed management which will keep the leaves moist during the shortest length of time compatible with the production of good plants.

9. If the disease appears in certain spots in the bed, these spots, along with a broad margin of plants which appear healthy, should be killed by drenching with 1/10 formaldehyde.

10. Pull plants for setting only from disease-free beds.

11. Starting as soon as the plants have recovered and begun to grow in the field, make frequent inspections and remove every diseased plant from the field.

12. Do not work in a field where there is any wildfire while the leaves are wet.

13. Removal of diseased leaves at intervals of three or four days, where the infection when first found is light, will reduce the number of centers of spread and may materially reduce the percentage of wildfire in the crop when harvested.

14. Rotate tobacco with other crops if practicable.

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AGRICULTURAL EXPERIMENT STATION

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COMBATING APPLE SCAB

SPRAYING AND DUSTING EXPERIMENTS IN 1922

By WEBSTER S. KROUT

The scab fungus of the apple affects seriously the McIntosh Red, particularly as it is grown in the eastern apple region of the State. Nowhere in the State has scab yielded completely to the protective spraying and dusting methods commonly followed by apple growers. The Experiment Station started work on disease control in the fall of 1920. The outstanding fact to date is that of a high degree of control even in spite of adverse weather conditions. This bulletin gives the record of the 1922 operations, together with concise recommendations for protective treatment against the disease.

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BULLETIN No. 214.

DEPARTMENT OF BOTANY.

COMBATING APPLE SCAB.

SPRAYING AND DUSTING EXPERIMENTS IN 1922.[1]

BY WEBSTER S. KROUT.

Introduction.

The fact of control by both spraying and dusting is outstanding at the end of the second year's field study of this fungous disease. Weather conditions in both 1921 and 1922 were most adverse to successful spraying and dusting, and most favorable to scab infection, yet despite these handicaps almost perfect control was obtained.

These investigations were started in the fall of 1920. In the fall of 1921 a report of the results of the first year's work was published through the Extension Service of the College in a pamphlet entitled "Apple Scab and its Control." This bulletin presents to the practical orchardist a similar report for 1922.

The field work has been conducted in three orchards under the direct supervision of the writer. In three other orchards he was present whenever possible. The spraying experiments were in the orchards of Stephen Sabine of Groton and Harry L. Knights and H. L. Frost of Littleton. The dusting experiments were conducted in the orchards of Harry L. Knights and H. L. Frost of Littleton, A. N. Stowe of Hudson, George A. Marshall of Fitchburg and R. J. Fiske of Lunenburg. Especially helpful was the co-operation of J. W. Ames, superintendent of the Knights farm, Roy C. Wilbur, superintendent of the Frost farm, John J. Collins, superintendent of the Stowe farm, and the officers of the Nashoba Fruit Producers Association.

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[1] The writer is indebted to Prof. A. Vincent Osmun, head of the Department of Botany of the Massachusetts Agricultural Experiment Station, for many helpful suggestions during the progress of this study.

Apple Scab.

Apple scab presents one of the most serious problems of the commercial apple grower of Massachusetts. The disease is caused by a fungus which attacks the leaves, flowers, fruit, pedicels and twigs. It may attack any variety of apples, but is exceptionally severe on the McIntosh.

Every orchardist should endeavor to familiarize himself with the first symptoms of apple scab as they appear on the leaves, so that the disease may not reach the epidemic stage before he realizes the danger. Scab usually appears first on the lower side of the leaves as grayish or olive webby spots or blotches, darker than the normal surface of the leaf. The color deepens with age to dark brown or black. The spots on the upper surface of the leaves are first noticed as yellowish green discolorations, gradually deepening with age through olive brown to black. They are velvety, somewhat definite in outline, smaller than spots on the lower side, and have a tendency to become raised or convex.

The Causal Fungus.

The scab fungus passes the winter on the dead leaves, under the trees. In the autumn after the leaves fall the fungus continues growing, penetrating the interior of the leaf. Sometimes, in November, it begins to form the flask-shaped bodies (perithecia) in which mature winter spores (ascospores) are developed by the following spring. During the rainy periods of spring these spores are discharged, and, being extremely light, are carried upward by the air to the under surface of the leaves. The scab spots produced by this infection appear from eight to fifteen days later. These spots, almost as soon as they are noticeable, produce the summer spores in great quantities. These spores cause rapid spread of the disease.

Table I. — *Dates of Discharge of Winter Spores and of the First Appearance of Scab in 1921 and 1922.*

	1921.	1922.
First discharge of winter spores	April 26	May 2
First appearance of scab	May 12	May 18
Last discharge of winter spores	June 10	June 15

During both years the first spots were discovered on the lower side of the leaves at the time of the calyx spray. In other words, the first spots appeared as the petals were dropping.

Spraying Program for 1922.

A series of plots in triplicate were laid off in the three orchards previously mentioned. The sprays used were home-made Bordeaux mixture alone, home-made Bordeaux mixture and liquid lime-sulfur, home-made Bordeaux mixture and dry lime-sulfur, a 4–50 and a 3–50 dry lime-sulfur, liquid lime-sulfur, and liquid lime-sulfur plus lime.

Powdered arsenate of lead, at the rate of 2 pounds to 50 gallons of spray, and 40 per cent nicotine sulfate, at the rate of three-eighths pint to 50 gallons of spray, were used with all the different spray materials in the delayed-dormant, pink and calyx. In the fourth summer spray arsenate of lead was used but the nicotine was omitted.

In the Sabine and Knights orchards the plots were rectangular, 4 rows of 6 trees each, except the check at Sabine's which had 16 trees, and the Bordeaux–dry lime-sulfur plot at Knights' which had 20 trees. In the Frost orchard the plots consisted of single rows of 8 to 11 trees. The data were taken from 5 typical trees of the two middle rows of each plot in the Sabine and Knights orchards; and in the Frost orchard, from 5 typical trees of each row. The trees of each of the three sprayed orchards were approximately twelve years old.

Treatment of Plots.

All plots, except the checks, were given the delayed-dormant application. The plots in the Sabine and Knights orchards were sprayed with a 1–10 liquid lime-sulfur plus arsenate and nicotine. The plots in the Frost orchard were sprayed with a 15–50 dry lime-sulfur plus arsenate and nicotine. Plots 1 to 8 were conducted in each of the three orchards. Plots 9 to 11 were conducted only in the Frost orchard. The plots in the Sabine orchard were the only ones given the fifth summer spray. The detailed treatment of plots follows: —

Plot 1. — Check, unsprayed with fungicides. The same insecticides were used as on the other plots. A single check plot was used in each of the Sabine and Frost orchards. In the Knights orchard two check plots were necessary, because the Bordeaux plot was located in a separate block of trees.

Plot 2. — A 3–10–50 home-made Bordeaux mixture [1] for the pink spray, and a 1–50 liquid lime-sulfur for the calyx and following sprays.

Plot 3. — The same as plot 2, except that dry lime-sulfur was substituted for the liquid.

Plot 4. — 1–50 liquid lime-sulfur.

Plot 5. — 4–50 dry lime-sulfur.

Plot 6. — 1–50 liquid lime-sulfur plus 6 pounds of lump lime to 50 gallons of spray.

Plot 7. — A 3–10–50 home-made Bordeaux mixture for the pre-pink and pink, and liquid lime-sulfur for the calyx and succeeding sprays.

Plot 8. — A 3–10–50 home-made Bordeaux mixture only.

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[1] Directions for making Bordeaux mixture may be obtained by applying to the Extension Service, Massachusetts Agricultural College. Ask for Extension Leaflet No. 33.

Plot 9. — A 4–50 dry lime-sulfur for the pre-pink, pink and following sprays.

Plot 10. — A 3–50 dry lime-sulfur plus arsenate and nicotine.

Plot 11. — A 3–50 dry lime-sulfur plus nicotine sprayed on the trees, allowed to dry, and then the arsenate applied.

Time and Manner of Spray Applications.

TABLE II. — *Time of Application of Sprays for 1921 and 1922.*

Application.	1921.	1922.
Delayed-dormant	April 4– 6	April 13–19
Pre-pink	– –	April 28–May 3
Pink	April 25–27	May 3– 8
Calyx	May 10–12	May 16–20
Fourth summer	June 6– 8	June 9–22
Fifth summer	– –	June 25–31

As previously explained, two additional applications, the pre-pink and fifth summer, were made on some of the plots in 1922. Power sprayers which maintained approximately 200 pounds pressure were used, with spray rods equipped with the regular 45° Friend angle nozzles. By holding the rod close to the ground and in such a position as to shoot the sprays upward, the under surface of the lowest leaves was thoroughly covered. As these are the first leaves attacked by the scab fungus, it is exceedingly important that they be well covered at the pre-pink and pink applications.

Discussion of Results of Spraying.

Throughout most of the season weather conditions were exceedingly favorable for scab infection.

It will be noted in Tables IV, V and VI (pages 40 and 41) that all of the sprays gave exceptionally good control. In fact, many of the sprayed plots produced 100 per cent marketable fruit, whereas some of the checks produced fruit 100 per cent scabbed. There was not a single scab-free apple on the 16 check trees in the Sabine orchard, and 95 per cent were so badly scabbed that they were unmarketable. In the Knights orchard the situation was nearly as bad, 96 per cent of the fruit being scabbed and 69 per cent unmarketable. In the Frost orchard infection was not quite as severe, only 41 per cent of the fruit being scabbed.

Only small and probably insignificant differences were found in the results obtained from the different fungicides in so far as control of the scab fungus is concerned.

Importance of the First Spray Applications.

The dissemination of scab spores is most rapid about the time of the *pink* application. This is, therefore, the most important spray and should be so timed that it will be on the foliage, blossoms and pedicels of the

blossoms before the winter spores are discharged. Observations of the writer *indicate that most growers who fail to control scab apply the pink spray too late in the season.*

In some places a *pre-pink* spray is used in order to make certain that the fungicide is on the leaves before the scab spores are discharged. Explained in the most simple terms, this means setting the pink spray ahead from seven to ten days. It is a spray applied approximately midway between the delayed-dormant and the pink. At that time most of the cluster buds are still closed, and a few only of the most advanced blossom buds show slight amounts of pink. Tables IV, V and VI, plots 7 and 9, show that the series of plots on which the pre-pink spray was applied yielded exceptionally high percentages of both clean and marketable fruit.

If the orchardist were positive that the pink application could be made before the discharge of the winter spores, it would be unnecessary to use a pre-pink spray. The pre-pink application is intended primarily to eliminate this uncertainty connected with the pink treatment. The cost of the spray material at this application is a small item, as the arsenate and nicotine are omitted. As this application has been tested one year only in this State, the writer hesitates to recommend it to the small orchardist. To any orchardist who has three or more days of spraying at the pink application, it is to be recommended without hesitation.

Home-made Bordeaux and Lime-Sulfur.

A 3–10–50 home-made Bordeaux mixture used alone for all applications russeted the fruit and burned the foliage so badly that its use in this way will be discontinued. Foliage burn due to the Bordeaux was not evident until the latter part of the season.

For two years, a 3–10–50 home-made Bordeaux mixture for the pink spray, followed by a 1–50 liquid lime-sulfur for the calyx and succeeding sprays, has given the most satisfactory results. From Tables IV, V and VI it will be seen that this combination in Sabine's orchard produced 98 per cent marketable fruit, but fell slightly lower than some of the other plots in clean fruit. In the Knights and Frost orchards it produced 100 per cent marketable fruit.

Some of the fruit sprayed with the Bordeaux–liquid lime-sulfur combination described above was russeted slightly. The writer questions whether this was caused by the Bordeaux at the pink spray or by natural conditions, as about the same amount of russeting occurred on some of the unsprayed trees. Also, no russeting occurred on similarly treated plots in 1921. The russeting was slight and did not injure the sale of the fruit except where the apples were sold to a fancy trade. In 1921 lime-sulfur burned the blossom buds badly.

A test was made to determine if dry lime-sulfur used with home-made Bordeaux mixture was as effective for the control of scab as the liquid form. Tables IV, V and VI, plots 2 and 3, show that the dry form was practically as good as the liquid, except in the Sabine orchard, where for

some unexplained reason the Bordeaux–dry lime-sulfur plot yielded only 49 per cent clean fruit and 90 per cent marketable fruit. The fact that the total yield of this plot was exceptionally low may justify leaving it out of consideration.

Liquid Lime-Sulfur versus Dry Lime-Sulfur.

For two years dry lime-sulfur has given as good control of scab as the liquid form (Tables IV, V and VI). Four pounds of the dry form in 50 gallons of water have been used for all sprays except the delayed-dormant in most of the work, but judging from this year's results 3 pounds will give as good results. Some growers use only 2 pounds in 50 gallons, but in the opinion of the writer this is too dilute.

Dry lime-sulfur has the advantage of less bulk, and it is claimed that the fungicidal value is not injured by freezing. Both the dry and liquid forms of lime-sulfur used with lead will burn the foliage under certain conditions, but judging from the data at hand the liquid form seems to burn slightly more than the dry.

The Cost of Spraying.

In figuring the cost of spraying the writer has used the data from the experimental plots of 1922. It is assumed that there are 30 twelve-year-old McIntosh trees to the acre. Dry lime-sulfur and insecticides are used as indicated in the suggested spraying schedule for 1923: dry lime-sulfur, 15 pounds to 50 gallons of water for the delayed-dormant, and 4 pounds to 50 gallons of water for the four later applications; powdered lead arsenate, 2 pounds to 50 gallons of spray; and nicotine sulfate, three-eighths pint to 50 gallons of spray. Four gallons of spray are allowed for each tree. The cost of lime-sulfur is placed at 10½ cents per pound; powdered arsenate of lead at 14 cents per pound; and nicotine sulfate at $14 per gallon. Spraying with either liquid lime-sulfur or Bordeaux mixture costs slightly less than with dry lime-sulfur.

TABLE III. — *Cost of Spraying One Acre of Apple Trees.*

Applications.	Material.			Labor.		Total.
	Dry Lime-Sulfur.	Lead Arsenate.	Nicotine Sulfate.	Man.	Team.	
Delayed-dormant	$3 78	$0 67	$1 57	$0 70	$0 30	$7 02
Pre-pink	1 00	–	–	70	30	2 00
Pink	1 00	67	1 57	70	30	4 24
Calyx	1 00	67	1 57	70	30	4 24
Fourth summer	1 00	67	1 57	70	30	4 24
Total for five applications	$7 78	$2 68	$6 28	$3 50	$1 50	$21 74

Dusting Program for 1922.

The use of dusts for the control of apple scab is new in this State. Prior to 1921 the writer knew of only one dusting machine in the eastern part of the State, and that was used for dusting peaches. In 1921 dusting experiments were begun by the station in three orchards. The writer and growers who co-operated were inexperienced in the art of dusting, and consequently the dusts were not applied as well as they might have been. As a result, dusting compared very unfavorably with spraying.

In 1922 a number of growers bought dusting machines. With the experience of the previous year, and willingness on the part of growers to co-operate, extensive plans were made to test the efficacy of dusting materials for the control of apple scab. Accordingly, five orchards, previously mentioned, were chosen in which to locate the experiments. Two dusts, sulfur and a copper-lime-arsenate dust, were used in each orchard. Checks were used in all cases. The plots were all large, one of them containing 179 trees. Only McIntosh trees were used.

It will be noticed that there was no nicotine in any of our dusts. Nicotine makes a dust expensive, and the manufacturers state that it is difficult to manufacture a satisfactory sulfur dust high in sulfur with sufficient nicotine in it. As it happened, no nicotine was needed on any of the plots, but it was planned to spray with a nicotine solution or dust with a nicotine dust should infestation with sucking insects become serious.

Five representative trees of each dusted plot in the Marshall and Stowe orchards, 7 in the Knights orchard and 6 in the Frost orchard were chosen from which to take data. Also 3 representative trees of each undusted check in the Marshall and Knights orchards, 2 of one check in the Stowe orchard and 3 of the other (Table VII, plot 12) and 2 in the Frost orchard were chosen from which to take the data (Tables V, VI and VII, pages 40 and 41). The data of the Fiske orchard are not given as the trees were young and the yield exceptionally low.

Treatment of Plots.

Plots 13 and 14 in all the orchards were given the regular delayed-dormant spray with lime-sulfur. The plots in the Stowe orchard were given three dust applications, — the pre-pink, pink and fourth summer. The plots in the Frost and Fiske orchards had four applications, — the pre-pink, pink, calyx and fourth summer. The plots in the Knights orchard had five applications, — the pre-pink, pink, calyx, fourth and fifth summer. The plots in the Marshall orchard had nine applications, — the pre-pink, pink, calyx and six subsequent applications. The detailed treatment of plots follows: —

Plot 12. — Check untreated with fungicides, but sprayed with the usual insecticides.

Plot 13. — Sulfur dusts. The ordinary commercial dusting sulfur without insecticides was used for the pre-pink, fifth, sixth and seventh summer applications.

A sulfur dust, composed of 85 parts sulfur and 15 parts arsenate of lead, was used for the pink, calyx and fourth summer dusts.

Plot 14. — Copper-lime-arsenate dust for the pre-pink, pink and fourth summer applications only. An 85–15 sulfur dust was used at the calyx application, and dusting sulfur for treatments after the fourth summer application.

Time and Manner of Application.

The dusts were applied at approximately the same time as the sprays (Table II). Two different makes of power dusting machines were used. *The dusts were applied from two sides of the trees while the leaves were wet.* Dusting was started at 5 A.M. and continued until about 8 A.M. The best distribution of dust through the tree was accomplished by giving the hose a circular or a quick upward and downward movement. Care was taken to hit the lower leaves, especially at the pre-pink and the pink applications. The engine and duster should be on a low wagon or truck built especially for the purpose, so that the operator may shoot the dusts upward through the tree. Where rows of trees are too close together, this will hinder the operation of the duster.

Discussion of Results of Dusting.

In evaluating the results from dusting in 1922 it must be borne in mind that only a single year's work is represented, and that it is, therefore, decidedly unsafe and unsound to draw any conclusions whatever.

The data in Tables V, VI and VII show that the dusts gave excellent control of scab in a year most favorable for the development of the scab fungus. For example, in the Knights orchard the check for the dusts produced only 1 per cent marketable fruit, while the sulfur and copper-lime-arsenate dust plots produced 97 and 99 per cent marketable fruit. In the Frost orchard the check for the dusts produced 68 per cent marketable fruit; the sulfur dust plot, 96 per cent; and the copper-lime-arsenate plot, 97 per cent.

In the Stowe orchard the checks produced from 46 to 48 per cent marketable fruit; the dusted plots, 92 to 97 per cent. Table VII shows that in the Stowe orchard slightly better results were obtained on the younger trees than on the older. This, with the fact that practically all the scabby apples of the dusted plots were found in the tops of the trees, would indicate that the higher the tree the more difficult it is to apply the dust thoroughly. Although the results on the dusted plots were extremely good, it is evident that even better results might have been obtained had the dusts been more thoroughly applied to the topmost parts of the trees.

In several cases where late summer applications of lime-sulfur and dusts were made side by side in the same orchard, the lime-sulfur burned the foliage, while the sulfur dust caused no injury. Later observations showed that where the foliage was burned by the lime-sulfur, from 8 to 20 per cent of the fruit dropped prematurely; while where the sulfur dust was used, practically the entire crop remained on the trees.

It is quite evident that copper-lime-arsenate dust controlled scab more effectively than the sulfur dusts, as in three of four orchards it gave a higher percentage of clean and marketable fruit. *However, it cannot be recommended for apples on account of the russeting of the fruit and the burning of the foliage.* On the other hand, sulfur dusts neither injured the foliage nor russeted the fruit. If kept covered with the sulfur dust, the leaves grow normally and develop a dark green color. *Sulfur dust is cheap and is the only dust that has shown itself worthy of further trial.* It is possible that the copper-lime-arsenate dust may prove useful for the pre-pink and pink applications, to be followed with sulfur dust for the later applications. This combination will be tested another year.

In the Stowe and Marshall orchards there were no experimentally sprayed plots to compare with the dusted plots, but if we may judge from the results which these orchardists obtained on sprayed trees adjacent to the dusted plots, the sulfur dust was equal to the sprays.

The Effect of Apple Scab on the Vitality of the Tree.

The most striking example of what may be expected of an unsprayed McIntosh orchard may be seen on the check plot in Knights orchard (Table V, plot 1). The trees of this plot have not been sprayed with a fungicide since 1920, and in 1921 and 1922 they showed approximately 100 per cent infection of fruit and foliage. The heavy loss of foliage in 1921, in spite of the fact that the trees were fed heavily, caused a very light set of leaves and blossoms in the spring of 1922, and consequently a greatly reduced yield of fruit. Plots 1 and 2, Table V, are located side by side in the orchard. It is planned to shift the check plot in this orchard from its present location to some other part of the orchard in 1923, as permanent injury to the trees is feared.

The Relation of Weather to Spraying.

Spraying should always be done in advance of rain periods, since the fungicide must be on the leaves in advance of the germination of the spores. If allowed to dry thoroughly, efficient sprays do not wash off sufficiently to destroy their fungicidal value. By studying the low barometric areas of the daily weather reports, the grower should be able to predict, with some degree of accuracy, weather conditions two to three days in advance. [1]

Burning of Apple Foliage by Sprays and Dusts.

The foliage of some of the apple trees in the plots was badly burned with lime-sulfur during 1921, while in 1922 very little injury from this material was noticed. The writer believes that weather conditions were

[1] These daily reports may be obtained by addressing the United States Weather Bureau, Boston, Mass.

largely responsible for this difference. Temperature and humidity were quite high when many of the applications were made in 1921, while to a certain extent the opposite was true in 1922. *Apples should never be sprayed when temperature and humidity are both high, as burning of foliage is almost certain to result.*

The amount of spray applied does not seem to be as important a factor in burning the foliage as was formerly thought. In 1922 the writer selected trees in several plots in the Sabine and Knights orchards and thoroughly drenched them with the spray at the pink and calyx applications. At the end of the season the trees showed only slight injury.

Sulfur dusts have never burned the foliage, while burning from copper-lime dust is frequent.

Recommendations for 1923.

Spraying Program.

It should be borne in mind that the spray schedule which follows is based on only two years of experimental work, and therefore is subject to change. Where two or more spray materials are given, the first is preferable and should be used whenever possible.

Delayed-dormant. — Fifteen pounds of dry lime-sulfur dissolved in 50 gallons of water, or 1 gallon of liquid lime-sulfur in 9 gallons of water.

Pre-pink. — A 3–10–50 home-made Bordeaux mixture, or 3 to 4 pounds of dry lime-sulfur dissolved in 50 gallons of water, or 1 gallon of liquid lime-sulfur in 49 gallons of water.

Pink. — A 3–10–50 home-made Bordeaux mixture, or 3 to 4 pounds of dry lime-sulfur dissolved in 50 gallons of water, or 1 gallon of liquid lime-sulfur in 49 gallons of water.

Calyx. — Three to 4 pounds of dry lime-sulfur dissolved in 50 gallons of water, or 1 gallon of liquid lime-sulfur in 49 gallons of water.

Fourth and Fifth Summer. — Same as the calyx. Unless the rainfall of June, July and August is above normal, the fifth summer spray may not be necessary for the control of scab. On the other hand, if these months are rainy and scab is bad, the fifth summer application will be found very profitable.

Three-eighths of a pint of 40 per cent nicotine sulfate to each 50 gallons of spray is used at the delayed-dormant, pink and calyx applications. Also, 2 pounds of powdered lead arsenate to each 50 gallons of spray are used at the delayed-dormant, pink, calyx and fourth summer applications.

Dusting Program.

If a dusting program is to be followed, the delayed-dormant spray should be applied. *Dusting sulfur* should be used for the *pre-pink* and for all applications after the fourth summer dust. A dust composed of 90 parts sulfur and 10 parts arsenate of lead should be used for the pink; an 85–15 dust for the calyx and fourth summer applications. In case

sucking insects are bad, it will be necessary to spray the trees with three-eighths pint of 40 per cent nicotine sulfate in 50 gallons of water, or dust the trees with a commercial nicotine dust.

Miscellaneous.

Dry lime-sulfur passes through the spraying outfit better if it be allowed to stand in water about forty minutes before it is poured into the spray tank. Before going to the orchard with each tank of spray material, it is a good plan to weigh out the desired amount for the next tank in a 5 or 6 gallon pail, pour water over it and agitate with a wooden paddle for a few minutes. On returning, the spray tank is filled about two-thirds full of water, the agitator set in motion, the lime-sulfur from the pail poured into the tank, and the tank filled with water. Some growers consider soaking of the material unnecessary before putting it into the tank.

Lime-sulfur should be well agitated before it is applied to the trees as a too concentrated solution will burn the foliage.

Twelve-year-old trees with a height and spread of approximately 20 feet should receive about 4 gallons of spray material with each application.

Follow the spraying system outlined for 1921.[1] It is better to spray against the wind than with it, as less spray materials are wasted and a better covering is obtained.

The engine and duster of the dusting outfit should be on a low wagon or truck built especially for the purpose, so that the operator may shoot the dust upward through the tree. Special effort should be made to hit the extreme tops of the trees. Best results are obtained by giving the hose of the duster a quick circular or an up-and-down movement so as to hit all parts of the tree. Dusting should be done only when the surfaces of the leaves are moist. At least two sides of the trees should be dusted. On trees twelve to fifteen years old, approximately $1\frac{1}{2}$ pounds of dust should be used on each tree at each application.

[1] Extension Circular, "Apple Scab and its Control." This may be obtained by applying to Extension Service, Massachusetts Agricultural College.

Tabulated Results.

Tables IV to VII give briefly the results on the sprayed and dusted plots in each of the orchards during 1922.

Table IV. — *Results on the Sprayed Plots in Sabine Orchard.*

Plot.	Treatment.	Clean Fruit (Per Cent).	Scab (Per Cent).	Marketable Fruit (Per Cent).	Russeted Fruit (Per Cent).
1	Check, arsenate and nicotine only .	0	100	5	0
2	Home-made Bordeaux (pink) and liquid lime-sulfur.	84	16	98	0
3	Home-made Bordeaux (pink) and dry lime-sulfur.	49	51	90	0
4	Liquid lime-sulfur	86	14	97	0
5	Dry lime-sulfur, 4-50	86	14	95	0
6	Liquid lime-sulfur plus lime . .	76	24	91	0
7	Home-made Bordeaux (pre-pink and pink) and liquid lime-sulfur.	81	19	96	0
8	Home-made Bordeaux . . .	87	13	97	52

Table V. — *Results on the Sprayed and Dusted Plots in Knights Orchard.*

Plot.	Treatment.	Clean Fruit (Per Cent).	Scab (Per Cent).	Marketable Fruit (Per Cent).	Russeted Fruit (Per Cent).
1	Check for plots 1 to 7, arsenate only .	4	96	31	0
2	Home-made Bordeaux (pink) and liquid lime-sulfur.	98	2	100	0
3	Home-made Bordeaux (pink) and dry lime-sulfur.	97	3	99	0
4	Liquid lime-sulfur	96	4	99	0
5	Dry lime-sulfur, 4-50	92	8	97	0
6	Liquid lime-sulfur plus lime . .	93	7	99	0
7	Home-made Bordeaux (pre-pink and pink) and liquid lime-sulfur.	99	1	100	1
8	Home-made Bordeaux . . .	87	13	95	47
12	Check for Bordeaux and dusts only .	0	100	1	0
13	Sulfur dust	84	16	97	0
14	Copper-lime-arsenate dust . . .	93	7	99	22

TABLE VI. — *Results on the Sprayed and Dusted Plots in Frost Orchard.*

Plot.	TREATMENT.	Clean Fruit (Per Cent).	Scab (Per Cent).	Marketable Fruit (Per Cent).	Russeted Fruit (Per Cent).
1	Check for plots 1 to 11, arsenate and nicotine only.	59	41	90	Negligible.
2	Home-made Bordeaux (pink) and liquid lime-sulfur.	100	0	100	Negligible.
3	Home-made Bordeaux (pink) and dry lime-sulfur.	99	1	100	Negligible.
4	Liquid lime-sulfur	98	2	99	Negligible.
5	Dry lime-sulfur, 4-50	98	2	100	Negligible.
6	Liquid lime-sulfur plus lime . .	90	10	98	Negligible.
7	Home-made Bordeaux (pre-pink and pink) and liquid lime-sulfur.	99	1	100	1
8	Home-made Bordeaux . . .	100	0	100	13
9	Dry lime-sulfur, 4-50, on pre-pink, pink, etc.	100	0	100	Negligible.
10	Dry lime-sulfur, 3-50	96	4	98	Negligible.
11	Dry lime-sulfur, 3-50 (lead and lime-sulfur put on separately).	96	4	100	Negligible.
12	Check for plots 13 and 14 . . .	34	66	68	Negligible.
13	Sulfur dust	89	11	96	0
14	Copper-lime-arsenate dust . .	86	14	97	13

TABLE VII. — *Results on the Dusted Plots in Stowe and Marshall Orchards.*

STOWE ORCHARD.

Plot.	TREATMENT.	Clean Fruit (Per Cent).	Scab (Per Cent).	Marketable Fruit (Per Cent).	Russeted Fruit (Per Cent).
12	Check for 25-year-old trees, sprayed with lead and nicotine only.	15	85	48	0
13	Sulfur dust, 25-year-old trees . .	74	26	92	0
14	Copper-lime-arsenate dust, 25-year-old trees.	87	13	97	21
12	Check for 12-year-old trees, sprayed with lead and nicotine only.	16	84	46	0
13	Sulfur dust, 12-year-old trees . .	83	17	96	0

MARSHALL ORCHARD.

12	Check, sprayed with lead and nicotine only.	56	44	96	0
13	Sulfur dust	84	16	99	0
14	Copper-lime-arsenate dust . . .	93	7	100	26

MASSACHUSETTS

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PEDIGREE

THE BASIS OF SELECTING BREEDING MALES FOR EGG PRODUCTION

By F. A. HAYS and RUBY SANBORN

In this bulletin the records of ten years' poultry breeding investigations at the Massachusetts Agricultural Experiment Station are analyzed, specifically from the standpoint of the effect of the female ancestry on the transmitting power of the male. It is shown that the pedigree record basis of selection of the male has given marked results. On the other hand, there is nothing in the work done to date which in any way indicates superiority of this method over that of measuring transmitting power by means of the progeny test.

Available records, however, do indicate that the selection of females on the basis of those specific characters which together are believed to make up the group character of fecundity may be even more important in its results than the particular basis on which the male is selected.

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BULLETIN No. 215.

DEPARTMENT OF POULTRY HUSBANDRY.

PEDIGREE, THE BASIS OF SELECTING BREEDING MALES FOR EGG PRODUCTION.[1]

BY F. A. HAYS AND RUBY SANBORN.

Introduction.

The practical importance of the selection of breeding males in flocks bred for egg production is much appreciated by poultrymen. Some believe that the ability of hens to make good egg records is more largely traceable to their male ancestors than to their female ancestors. At any rate, the fact is well recognized that the male breeders must be carefully considered in developing a flock uniform for high production. Since actual egg production can be measured only by the females of the flock, other criteria must be employed in choosing the males. Some breeders prefer to use cockerels, while others make use of yearling or older cocks for breeding; but the merits or demerits of these practices will not be discussed in this paper. The following discussion of data available at the Massachusetts Experiment Station has a bearing on methods of selection that may be applied to both cockerels and cocks (Inherited Production), and other methods that apply only to cocks (Potential Production). Experimental evidence on the transmission of egg-producing ability through the male is in a confused state at present.

Pearl, '12, concludes, after studying the inheritance of egg production with several thousand Barred Plymouth Rocks representing thirteen generations: (p. 284) "That the record of egg production or fecundity of a hen is not of itself a criterion of any value whatsoever from which to predict the probable egg production of her female progeny. An analysis of the records of production of large numbers of birds shows beyond any possibility of doubt that, in general, there is no correlation between the egg production of individuals and either their ancestors or their progeny." Pearl draws the above conclusions because he found no significant biometric correlation between mothers and daughters or between daughters and their female ancestry in egg production. Pearl states, on the other hand, (p. 379), "High fecundity may be inherited by daughters from their sire, independent of the dam."

Goodale, '19, believes that egg production is transmitted equally through males and females in Rhode Island Reds. He further crossed Cornish males on Rhode Island Red females and secured winter egg production corresponding with that of his Rhode Island Red flock.

Lippincott, '20, in discussing the grading up of mongrel flocks by the use of standard-bred cockerels of three breeds, (p. 45), states that a pullet's egg produc-

[1] The data included in this bulletin were collected by Dr. H. D. Goodale, until recently in charge of poultry investigations at this Station. All Rhode Island Red fowls bred by the Experiment Station from 1912 to 1921 are included, with the following exceptions: a small number of birds in an experiment in studying the behavior of broodiness, and a small number of birds in an inbreeding experiment during the year 1921. The flock included in this report differs from that reported on in Bulletin No. 211 of this Station in that only fowls in the experiment entitled *Breeding for Egg Production* are reported in Bulletin No. 211.

tion seems to bear a closer relation to the breeding of her sire than to the production of her dam.

Dryden, '21, reporting on eight generations of Barred Rocks, eight generations of Leghorns and eight generations of Cross-breds, states that some hens and some males have the power of transmitting high fecundity; others have not this power. He advises the progeny test as the most reliable method of selecting breeders.

Hurst, '21, in his work in breeding White Leghorns and Wyandottes, found no sex linkage in the inheritance of factors for egg production. In other words, he agrees with Goodale and Dryden in his assumption that both parents contribute equally in factors for egg production.

Other authorities rather generally agree with one or the other of the above schools, so that it seems safe to assume that egg production is transmitted in Mendelian fashion from parent to offspring. A discussion of the several proposed genetic theories is not within the province of this report. Whether or not factors for egg production are transmitted in the same fashion in all breeds requires further study. This report is intended to throw some light on the expected progress in mass breeding without considering definite Mendelian factors as operating to control the egg production of the flock.

Review of Progress in the Flock.

The data upon which this report is based cover ten years' work at the Massachusetts Agricultural Experiment Station in breeding Rhode Island Red fowls primarily for egg production. The foundation flock of 100 pullets and eggs from which 50 more were hatched were purchased in the fall of 1912 from a Massachusetts breeder. These were good representatives of the breed, judged by the breed standards of that time. This foundation female stock was placed in the laying houses December, 1912, and all females in the experiment have since been trap-nested at all times unless physically incapacitated. All annual records cover 365 days and were made during the pullet year. Complete pedigrees of all breeding stock have been maintained throughout the period. The foundation males used consisted of twelve birds brought in in the spring of 1913, four from different breeders brought in in 1914, and ten from other outside sources brought in in 1915. Since 1915 no outside stock has been used in the flock.

Dr. Goodale has already given the question of egg production much study and made several reports on the egg-laying flock up to the end of the laying year 1921. His reports include a rather complete study on early maturity, rate and winter pause (Goodale, '18, '19). He has also carefully investigated the question of broodiness (Goodale, '20). This paper deals only with the application of methods for selecting breeding males, from data secured up to the end of 1922.

The average production of the flock by years is presented graphically in Chart I. All pullets that had an opportunity to lay for 364 days after their first egg are included. The birds are divided into six classes for study, and the percentage in each class is presented by years to show the general trend of the flock.

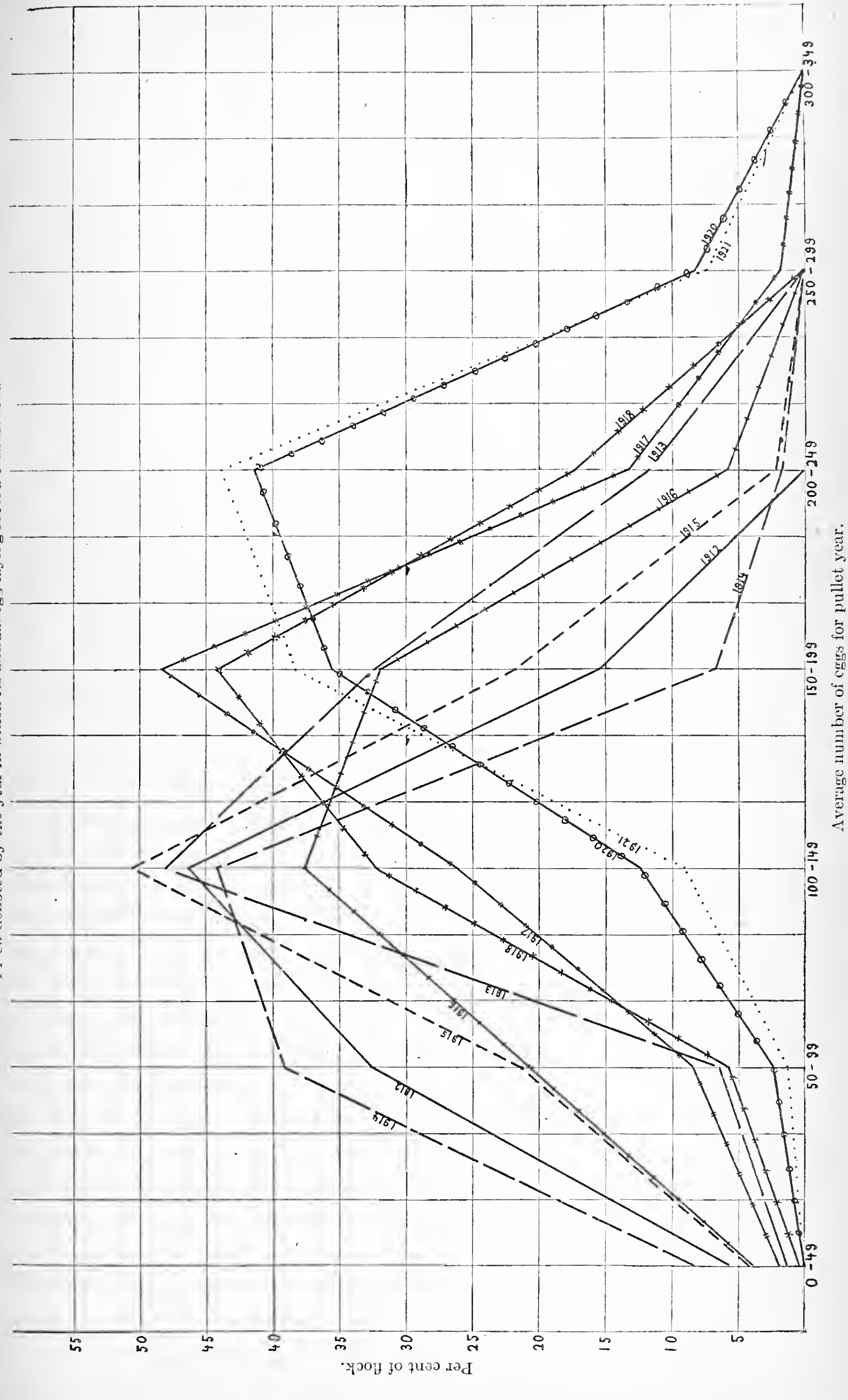
The total number of annual records at the close of 1922 was 1,945. The observation may be made that the mode (most common class) of the foundation stock lies between 100 and 149. Chart I further shows that the mode of the flock remained between 100 and 149 eggs until the 1917 pullets finished their year in the fall of 1918. This fact does not signify a lack of progress in increasing the egg production of the flock between 1913 and 1918. There was a total increase during this period up to the end of the laying year ending in 1918 amounting to an average of 12.97 eggs per hen. The graph for the hatching year 1913 would seem to indicate a higher degree of production in the flock as a whole than could be maintained in the flocks hatched in 1914 and 1915. This is only an apparent discrepancy, however, as explained by the fact that only about half the available flock hatched in 1913 could be trap-nested to the end of their laying year. The half selected represented those having the highest record for the first half of their year and consequently are a select group.

The distribution of the flock will be seen to remain almost the same for the birds

CHART I.

FREQUENCY DISTRIBUTION IN EGG PRODUCTION.

Flock denoted by the year in which its annual egg-laying record commenced.

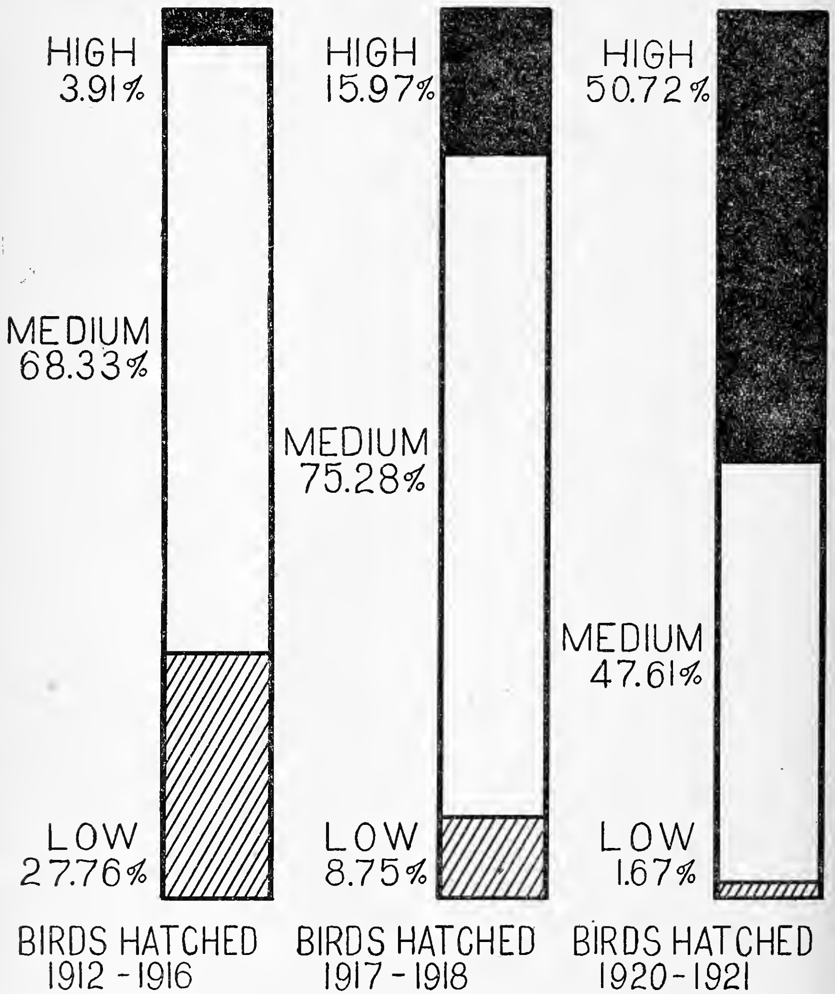


hatched in 1917 and 1918. Records for the flock hatched in 1919 were cut short by disease outbreaks. It was found necessary to dispose of most of the stock and exercise rigid quarantine measures. This prevented the completion of any annual records during 1920.

Referring again to Chart I, the mode of the flock will be observed to have advanced in 1920 to the 200 to 249 egg class, with a skewness indicating that the mode of the flock lies considerably above the average. In other words, a bimodal condition begins to present itself.

CHART II.

General Classification of Birds on the Basis of Production.



The results of the season ending in 1922 indicate that the general distribution of the 1921 flock conforms closely with that of 1920. The graph for 1921 also shows a bimodal condition of the flock, lying in the 150 to 199 class and in the 200 to 249 class.

Chart II is presented as supplementary to Chart I. Chart I shows that the most common group of producers falls in the 100 to 149 egg class in the years 1912 to

1916 inclusive; in the 150 to 199 egg class in the years 1917 and 1918; and in the 200 to 249 egg class in the years 1920 and 1921. Hence in the preparation of Chart II the birds hatched during the first five years have been grouped into one polygon, those hatched in the next two years into a second polygon, and those hatched in the last two years into a third polygon. Low producers laid from 0 to 99 eggs in their pullet year; medium producers laid from 100 to 199 eggs in their pullet year, high producers laid over 200 eggs in their pullet year.

Chart II shows that in the first five years there were 27.76 per cent low producers, 68.33 per cent medium producers and 3.91 per cent high producers. During the two-year period following, the percentage of low producers fell to 8.75, the medium class increased to 75.28 per cent, and the high producers increased to 15.97 per cent. During the last two years, the low class fell to 1.67 per cent, the medium class fell to 47.61 per cent, and the high class increased to 50.72 per cent.

Table 1, presented below, gives the number of sires used, the number of dams used, the number of pullets completing yearly records, and the average of all annual records by breeding years. The last column includes pullets hatched in the respective mating years.

TABLE 1.

MATING YEAR.	Number of Sires used.	Number of Dams used.	Number of Pullets with Yearly Records from Mating.	Average Annual Production of Pullets.
1913	12	42	77	146.22
1914	20	55	120	102.33
1915	21	99	378	122.93
1916	18	59	426	131.87
1917	14	52	318	159.19
1918	14	71	208	160.24
1919	12	29	None	None
1920	16	36	121	196.95
1921	9	43	297	197.89

Referring to the first column of the table, it will be observed that during the first four years of the experiment the average number of males was about 18, while during the past five years the number was cut down to an average of about 13. This policy has given a greater opportunity to determine the breeding ability of the sires and to regulate future mating with a greater degree of certainty, because the breeding ability of the sires can be ascertained with a higher degree of accuracy when their progeny are trap-nested in large numbers. This fact made it possible to regulate matings more carefully along specific blood lines.

The number of dams used was greater during the first four years of the experiment than during the last five. The range in number of dams for the nine-year period is from 29 to 99. The use of fewer dams makes possible more rigid selection standards and probably is of value in reducing variability in the flock.

The average number of completed records per year is 243. In general, the mean annual production of the flock shows progress from year to year. The first results of breeding at the Station are shown opposite the mating year 1913. Seventy-seven pullets averaged 146 eggs. These 77 pullets represent a selected group from a larger number, and consequently show a higher average than the 120 pullets hatched in 1914. The offspring of 1915 brings the average of the flock up to 123 eggs, and from that time to the present there has been uninterrupted progress, except for the disease outbreak of 1920. The 121 pullets hatched in 1920 averaged 197 eggs. The 297 hatched in 1921 averaged approximately 198 eggs. There is no noticeable tendency in the flock to produce a few phenomenal records, but rather a general homogeneity in production. This tendency to uniformity is probably traceable to the methods of mating for specific characteristics, and to a certain degree of relationship within the flock.

Selecting Breeding Males on Production Pedigree.

Before proceeding further with this question, it is necessary to define a few terms that are used in this report. *Sire's inherited production* is calculated from the average annual egg records of the 31 dams in five ancestral generations of each sire. *Dam's inherited production* is calculated from the average annual egg production of the 31 dams in five ancestral generations of each dam. *Sire's potential production* is the average of the annual records of all his daughters made during their first laying year. It is the same as daughter's annual production, save in those cases where a sire was used for more than one year.

It is a common practice to select males for breeding that come from dams with high annual egg records. In some flocks the practice is to emphasize the egg records of as many of the dams back of the sire as possible. In such cases the annual egg record is used as the guide for selection in a large measure, rather than any specific characters that the individual and his relatives may possess.

Table 2.

Mating Year.	Sires' Inherited Production.	Sires' Potential Production.	Dams' Inherited Production.	Daughters' Average Production.
1913	Unknown	136.55	Unknown	146.22
1914	138.00	107.29	117.07	102.33
1915	152.35	123.05	125.49	122.93
1916	149.93	133.23	144.63	131.87
1917	156.49	160.31	153.16	159.19
1918	156.77	161.23	151.78	160.24
1919	167.13	Not recorded	158.02	Not recorded
1920	168.79	196.95	163.02	196.95
1921	174.47	197.89	173.67	197.89

The inherited production of the sires used for the mating years included in this report is given in Table 2. This inherited production amounted to an average of 138 eggs in 1914, 152.35 in 1915, 149.93 in 1916, and so on up to an average of 174.47 in 1921, showing that although untested males from the progeny standpoint were used, those in charge were able to select a superior class of males each year, based on average annual records and pedigree. The progress that has been made in the flock as a whole would seem to indicate that this is a commendable practice. Such a method can be followed by breeders who keep complete pedigree and trap-nest records of their flock. Breeding sires from such flocks should command a high figure and should be very much appreciated by all smaller breeders who are seeking to improve their flocks without the use of the trap-nest or pedigree system. This method would be especially useful for selecting the more desirable cockerels to be retained. Mature sires can be selected with a greater degree of certainty from their progeny test.

Relative Importance of Sire's and Dam's Pedigree.

A great deal of discussion and difference of opinion exists as to the relative importance of the sire and the dam in breeding for egg production. Poultry investigators differ in their opinion on this point, some holding that sex linkage makes the sire of greater importance than the dam, while others hold that sire and dam are of equal importance. In Chart III the average inherited production of the dams for each year is given as a dash line. A similar figure for the sire is given as a solid line. The actual annual production of the daughters coming from the mating of these sires and dams on their respective years is given as a dotted line. It should be understood that the egg record of the daughters was finished the year following the hatching year. These graphs are fitted to a straight line by the ordinary method of least squares.

Chart III very clearly indicates that selection on a mass basis from egg records alone will not be an insurance as to what the daughters will do during their first egg-laying year. Reference to the chart shows that the annual production of the daughters crossed the path of the inherited annual production of the dams during the year 1916, and the path of the inherited production of the sires during 1917. *The average annual record of the daughters has far outstripped their inherited production from sires and dams.* These facts are unmistakable evidence of the operation of many factors to influence annual egg production. From the year 1916 this flock was bred for specific characteristics, such as early maturity, lack of broodiness and lack of winter pause. Those hens which showed later maturity, broodiness, and a tendency to stop laying during the winter season were discriminated against as breeders, even though they had made good annual records. Another characteristic which was sought was intensity of production. Those females that showed intense winter production were favored as breeders over others in which the degree of intensity was less marked.

CHART III.

RELATION BETWEEN PARENTS' INHERITED AND DAUGHTERS' AVERAGE PRODUCTION.

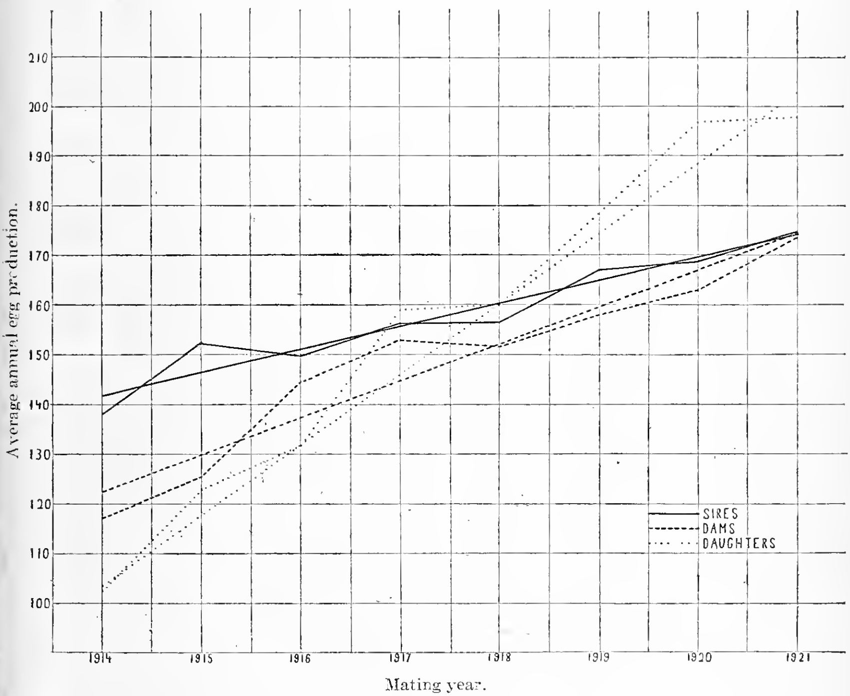


Chart III does not furnish any conclusive indication of the relative importance of sire and dam in transmitting annual egg production. This may be due to the fact that the chart is based on mass data. A similar chart based on specific families or blood lines would be more enlightening on this point. Data are available and will be published later. The one outstanding item to be emphasized on the chart is the advisability of selecting for specific characteristics as affecting annual egg yield.

The Sire's Potential Production as a Guide in Selecting Males.

The average annual egg production of the daughters of a sire we have called his potential production. In other words, in order to know the potential breeding ability of a sire, there must be a trap-nest record of his daughters. This fact greatly reduces the usefulness of the method with many poultrymen. Records at this Station indicate very clearly, however, that males vary widely in their ability to sire daughters that make high annual records. If it were possible to recognize such sires in advance, their usefulness in the flock could be made many fold greater. Referring back to Table 2: the column giving the sires' potential production is very similar to the average egg yield of the daughters for the respective years. It differs only in those cases where some of the sires were used for more than one breeding year. A comparison of this column with the one headed *Sires' Inherited Production* shows that in the early years the inherited production was higher than the potential production, but beginning in 1917 the reverse is the case; clearly indicating that the flock had been developed by the method of breeding to a higher degree of prepotency. This greater prepotency in the last four or five years is due to the fact that the flock has increased in the percentage of early maturing birds, in the percentage of birds that do not show the winter pause, in the percentage that are free from broodiness, and in the annual rate of production. As evidence of this fact, there are now families (all the daughters of a hen) that are non-broody. Other families show no winter pause, others show a uniformly higher rate, etc. There is still a wide range in the annual egg production of the females in the flock. This range may be explained on the Mendelian basis as we have shown elsewhere. The statement still holds good that there is no guide in selecting the sire that is as certain and reliable as the progeny test or the potential production.

How to Select Cockerels.

A great many poultrymen use cockerels to a considerable extent in their breeding operations; and even where cockerels are used only to a minor degree for breeding purposes the first year, it is necessary to select and reserve considerable numbers for future sires. Any guide in the selection of cockerels, then, has a double value to poultrymen.

We have previously shown that the average annual records of the hens in the dam's pedigree is of about the same value as the average annual record of the hens in the sire's pedigree, so far as determining what the daughters from such matings will produce is concerned. Selection of cockerels on their mothers' annual records alone is a very inefficient and inaccurate method, compared with the five-generation pedigree method we have used here. In our opinion, therefore, there is no other method of choosing the cockerels to be used in breeding for egg production that is as satisfactory as the combined sires' inherited production and dams' inherited production behind such cockerels.

How to Select Cocks.

Too much stress cannot be laid upon the importance of making full use of breeding males that have a demonstrated ability to sire heavy egg layers. The history of a good many flocks shows that the great producing hens from the flock trace directly to a very few outstanding males. The same principle holds here as in breeding the higher domestic animals. Sires of proven ability are invaluable.

The cock may be selected both on the pedigree basis and on the progeny test. The yearling cock will have daughters that have a winter record rather well along by his second mating season, if he has been used as a cockerel. Winter records are known to be of great value as guides to annual records. Therefore, the yearling cock can be selected with a good deal of certainty as to what contribution he will make to the flock. As a two-year-old, he will be a strictly tested individual; and if possessing the proper amount of vigor, and if properly handled, can be used

very successfully for two or more mating seasons. The items which are the guides to follow in selecting the cock may be summed up as follows:

1. Select those with a high inherited production, both on the sire and the dam side, for as many generations as possible.
2. Select those that have the best progeny performance.
3. Select those whose family are early maturers, free from broodiness, free from a tendency to winter pause, and show a high rate of production.

Summary.

1. In the space of nine years selection of breeding males, largely on an inherited production basis, has assisted in raising the average annual egg production during the pullet year from 146 eggs to 198 eggs per hen.
2. Evidence as presented in this report has no bearing on the value of the progeny test as a guide in the selection of breeding males.
3. Selection of males for production of daughters possessing specific characteristics, such as early maturity, lack of winter pause, high rate of production and freedom from broodiness, is necessary to attain high egg yields.

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AGRICULTURAL EXPERIMENT STATION

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DIGESTION EXPERIMENTS WITH CATTLE FEEDS

By J. B. LINDSEY, C. L. BEALS, P. H. SMITH, and J. G. ARCHIBALD

This bulletin reports results of digestibility studies on fourteen different materials, of real or claimed value as cattle feeds. The work of which this is a part was commenced thirty years ago. Results have been published in a number of reports and bulletins, and most of them summarized very briefly in a "Compilation of Analyses" published in November, 1919. Nearly all of the feed products available to Massachusetts dairymen have now been studied, and the digestibility of the nutrients contained measured. The publication of this bulletin, therefore, completes this phase of the service of the Massachusetts Experiment Station.

Publication of this Document
approved by the
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AGRICULTURAL EXPERIMENT STATION
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BULLETIN No. 216.

DEPARTMENT OF CHEMISTRY.

DIGESTION EXPERIMENTS WITH CATTLE FEEDS.

BY J. B. LINDSEY, C. L. BEALS, P. H. SMITH AND J. G. ARCHIBALD.[1]

Introduction.

The digestion experiments here reported cover a period of four years, the work commencing annually about November 1 and extending through to mid-April or thereabouts. Methods followed in conducting the tests are given elsewhere.[2]

Each digestion period extended over sixteen days, nine of which were preliminary (five in ordinary pens and four in the digestion stall), the last seven constituting the actual trial during which the feces were collected. The animals were grade sheep, as nearly as possible of the same age and weight. The basal ration was either English hay, or English hay and gluten feed. Ten grams of salt were fed daily and water *ad libitum*.

Discussion of Results.

A summary of the coefficients of digestibility is here presented, together with a brief discussion of the same.

English Hay.

Lot.	Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
1[3]	XXIII	1	9	57.90	45.16	47.35	61.90	59.67	43.90
1	XXIII	1	11	58.89	45.57	48.27	63.43	60.29	46.98
Average				58.40	45.37	47.81	62.67	59.98	45.44
2	XXIII	10	9	57.83	35.84	47.56	66.16	56.61	36.45
2	XXIII	10	11	60.59	41.43	53.47	67.73	59.40	40.35
2	XXIII	11	15	57.22	47.88	46.89	64.05	55.78	30.54
2	XXIII	11	17	56.76	46.81	45.44	64.38	55.15	24.83
2	XXIII	13	12	58.78	43.20	46.66	64.42	59.77	20.28
2	XXIII	13	13	60.68	28.11	49.25	67.97	61.43	23.22
2	XXIV	10	15	50.71	32.05	43.48	59.24	48.08	33.91
2	XXIV	10	16	53.30	20.57	39.43	63.65	51.12	38.53
Average				56.98	36.99	46.52	64.70	55.92	31.01

[1] Mr. Beals had immediate supervision of the experiments and did some of the analytical work. Mr. Smith, assisted by Miss E. M. Bradley, did the larger part of the analytical work. The tabulations were made by Mr. Archibald. The work at the feeding barn was done by Mr. J. R. Alcock.

[2] Mass. Agr. Expt. Sta., 11th Ann. Rpt., pp. 146–149, 1893.

[3] This lot of hay is the same as was fed in Series XXII, periods 8–17, coefficients of which are published in Mass. Agr. Expt. Sta. Bul. 181, p. 307.

English Hay — Concluded.

Lot.	Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitro-gen-free Extract.	Fat.
3	XXV	2	12	59.20	24.26	55.74	64.33	61.22	46.83
3	XXV	2	13	56.77	20.53	49.81	64.67	57.75	43.65
3	XXV	3	9	64.07	39.80	57.06	69.98	65.04	44.97
3	XXV	3	11	61.42	34.17	57.13	67.29	62.48	38.96
3	XXV	9	15	59.41	39.01	58.85	63.21	59.97	50.67
3	XXV	9	16	60.03	37.19	55.28	65.37	60.83	47.57
3	XXVI	1	17	59.95	29.40	54.92	65.68	61.19	46.97
3	XXVI	1	18	64.17	40.54	61.14	68.41	65.29	50.83
3	XXVI	1	19	59.89	34.96	55.22	63.78	61.73	45.76
Average				60.55	33.32	56.13	65.86	61.72	46.25
General average of above				58.82	36.13	51.21	65.03	59.09	39.75
General average, 5 earlier lots				59.47	36.31	49.78	64.10	62.35	46.34
Timothy hay, for comparison				55.00	39.00	47.00	51.00	62.00	50.00

Note. — Each series represents one winter's work, commencing about November 1 of each year and extending through to mid-April or thereabouts.

Three separate lots of hay were used in these experiments. It was of quite uniform quality and composition and consisted of mixed grasses, largely Kentucky blue grass, sweet vernal grass and some clover. It averaged in percentage of dry matter, 6.07 ash, 7.95 protein, 33.81 fiber, 49.52 nitrogen-free extract, and 2.65 fat. Such hay is rather richer in protein and has a higher degree of digestibility than has average timothy hay. The digestion results are on the whole quite uniform. It is interesting in this connection to compare the general average of the present results with the average of five earlier lots here cited and originally reported in Bulletin 181 of this Station. The close agreement of the two sets of coefficients in all items except fat emphasizes the fact that, when any considerable number of results are averaged, the resultant average is a pretty close approximation to accuracy and an accepted standard, even though there be considerable variation among the individual data.

English Hay and Gluten Feed — Basal.

Lot.		Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Hay.	Gluten Feed.									
2	1	XXIV	1	9	63.70	32.02	62.98	65.43	66.74	48.22
2	1	XXIV	1	11	67.31	40.75	69.24	68.37	69.51	54.82
2	1	XXIV	14	12	65.09	46.22	66.29	66.95	66.58	41.34
2	1	XXIV	14	13	65.56	45.61	67.57	66.77	67.28	43.39
3	2	XXV	1	9	64.81	29.53	69.27	66.40	67.34	54.79
3	2	XXV	1	11	67.89	30.57	71.20	70.67	70.42	56.32
3	2	XXV	4	12	66.72	27.44	71.59	67.20	69.63	55.02
3	2	XXV	4	13	66.62	20.55	73.19	67.66	69.48	54.30
3	2	XXV	6	15	67.68	27.40	72.71	67.58	70.88	55.92
3	2	XXV	6	16	65.92	20.94	70.34	66.14	69.44	55.55
3	2	XXVI	3	17	64.88	23.73	68.85	66.81	68.21	44.94
3	2	XXVI	3	18	65.46	23.16	65.11	72.39	67.01	46.96
3	2	XXVI	3	19	64.79	28.18	70.91	66.69	66.92	48.48

Note. — In all of these trials with the exception of period 3, Series XXVI, the ration fed was *500* grams of hay and 150 grams of gluten feed. In the exception noted, the ration was *550* grams of hay and 150 grams of gluten feed. Because of this difference in the ration fed, these results are not averaged.

Experience has proved that gluten feed is a satisfactory supplement to hay for use in basal rations. The necessity for such a supplement is greatest when the material under test is deficient in protein or is of a coarse, fibrous, unpalatable nature.

Gluten Feed.

Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXIV	1	9[1]	79.37	negative	73.56	37.80	89.76	70.95
XXIV	1	11	94.97	54.09	85.35	92.46	99.83	92.21
XXIV	14	12	82.09	123.50	82.51	83.85	83.86	77.25
XXIV	14	13	84.12	118.34	84.93	80.66	86.40	83.11
XXV	1	9[1]	70.86	negative	81.24	26.30	77.02	87.85
XXV	1	11	84.26	negative	85.05	96.50	89.06	93.31
XXV	4	12	95.72	56.84	89.86	102.10	100.55	84.34
XXV	4	13	95.28	12.76	93.03	109.94	99.95	81.53
XXV	6	15[1]	93.23	negative	88.09	125.06	101.97	76.91
XXV	6	16	85.60	negative	83.41	100.55	96.40	75.42
XXVI	3	17	79.23	negative	81.70	82.49	84.62	29.55
XXVI	3	18[1]	93.37	negative	79.99	281.89	88.37	38.32
XXVI	3	19	78.83	negative	86.21	80.19	79.27	50.86
Average			86.68	–	85.78	92.08	91.10	74.18
Average all previous trials			91.08	–	86.11	124.21	93.56	72.38

[1] Not included in the average.

The average composition and limits of variation of the two lots of gluten feed used in these experiments were as follows: dry matter 90 per cent (87.80–91.22), made up of ash 3.35 (2.52–4.74), protein 27.56 (24.53–29.50), fiber 6.83 (6.31–7.31), nitrogen-free extract 59.16 (56.44–62.52), fat 3.11 (2.08–4.31). The digestion coefficients for gluten feed were secured by applying the coefficients obtained for hay to the amount of hay fed, and deducting the product from the total digestible matter of the basal ration.

The negative results for ash in a majority of the trials are almost always noticed in work with gluten feed. No satisfactory explanation for such results can be given although they may be attributed in part to experimental error due to the small amount of ash present, and in part to the excretion of digested mineral matter from the intestines. In the case of fiber, it will be noticed that occasionally the coefficients were above 100 per cent, due probably to improvement in digestibility of the fiber in the hay as the result of adding a protein concentrate.

Incidentally it may be remarked that as a result of five separate trials with corn bran, the fiber was found to have an average digestibility of 75.12 per cent. This, together with the results secured for the fiber in gluten feed, shows that the fiber in corn is quite well utilized.

The present data, as well as those obtained as a result of many previous trials, show gluten feed to be a highly digestible protein concentrate.

English Hay — Concluded.

Lot.	Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3	XXV	2	12	59.20	24.26	55.74	64.33	61.22	46.83
3	XXV	2	13	56.77	20.53	49.81	64.67	57.75	43.65
3	XXV	3	9	64.07	39.80	57.06	69.98	65.04	44.97
3	XXV	3	11	61.42	34.17	57.13	67.29	62.48	38.96
3	XXV	9	15	59.41	39.01	58.85	63.21	59.97	50.67
3	XXV	9	16	60.03	37.19	55.28	65.37	60.83	47.57
3	XXVI	1	17	59.95	29.40	54.92	65.68	61.19	46.97
3	XXVI	1	18	64.17	40.54	61.14	68.41	65.29	50.83
3	XXVI	1	19	59.89	34.96	55.22	63.78	61.73	45.76
Average				60.55	33.32	56.13	65.86	61.72	46.25
General average of above				58.82	36.13	51.21	65.03	59.09	39.75
General average, 5 earlier lots . . .				59.47	36.31	49.78	64.10	62.35	46.34
Timothy hay, for comparison . . .				55.00	39.00	47.00	51.00	62.00	50.00

Note. — Each series represents one winter's work, commencing about November 1 of each year and extending through to mid-April or thereabouts.

Three separate lots of hay were used in these experiments. It was of quite uniform quality and composition and consisted of mixed grasses, largely Kentucky blue grass, sweet vernal grass and some clover. It averaged in percentage of dry matter, 6.07 ash, 7.95 protein, 33.81 fiber, 49.52 nitrogen-free extract, and 2.65 fat. Such hay is rather richer in protein and has a higher degree of digestibility than has average timothy hay. The digestion results are on the whole quite uniform. It is interesting in this connection to compare the general average of the present results with the average of five earlier lots here cited and originally reported in Bulletin 181 of this Station. The close agreement of the two sets of coefficients in all items except fat emphasizes the fact that, when any considerable number of results are averaged, the resultant average is a pretty close approximation to accuracy and an accepted standard, even though there be considerable variation among the individual data.

English Hay and Gluten Feed — Basal.

Lot.		Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Hay.	Gluten Feed.									
2	1	XXIV	1	9	63.70	32.02	62.98	65.43	66.74	48.22
2	1	XXIV	1	11	67.31	40.75	69.24	68.37	69.51	54.82
2	1	XXIV	14	12	65.09	46.22	66.29	66.95	66.58	41.34
2	1	XXIV	14	13	65.56	45.61	67.57	66.77	67.28	43.39
3	2	XXV	1	9	64.81	29.53	69.27	66.40	67.34	54.79
3	2	XXV	1	11	67.89	30.57	71.20	70.67	70.42	56.32
3	2	XXV	4	12	66.72	27.44	71.59	67.20	69.63	55.02
3	2	XXV	4	13	66.62	20.55	73.19	67.66	69.48	54.30
3	2	XXV	6	15	67.68	27.40	72.71	67.58	70.88	55.92
3	2	XXV	6	16	65.92	20.94	70.34	66.14	69.44	55.55
3	2	XXVI	3	17	64.88	23.73	68.85	66.81	68.21	44.94
3	2	XXVI	3	18	65.46	23.16	65.11	72.39	67.01	46.96
3	2	XXVI	3	19	64.79	28.18	70.91	66.69	66.92	48.48

Note. — In all of these trials with the exception of period 3, Series XXVI, the ration fed was *500* grams of hay and 150 grams of gluten feed. In the exception noted, the ration was *550* grams of hay and 150 grams of gluten feed. Because of this difference in the ration fed, these results are not averaged.

Experience has proved that gluten feed is a satisfactory supplement to hay for use in basal rations. The necessity for such a supplement is greatest when the material under test is deficient in protein or is of a coarse, fibrous, unpalatable nature.

Gluten Feed.

Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXIV	1	9[1]	79.37	negative	73.56	37.80	89.76	70.95
XXIV	1	11	94.97	54.09	85.35	92.46	99.83	92.21
XXIV	14	12	82.09	123.50	82.51	83.85	83.86	77.25
XXIV	14	13	84.12	118.34	84.93	80.66	86.40	83.11
XXV	1	9[1]	70.86	negative	81.24	26.30	77.02	87.85
XXV	1	11	84.26	negative	85.05	96.50	89.06	93.31
XXV	4	12	95.72	56.84	89.86	102.10	100.55	84.34
XXV	4	13	95.28	12.76	93.03	109.94	99.95	81.53
XXV	6	15[1]	93.23	negative	88.09	125.06	101.97	76.91
XXV	6	16	85.60	negative	83.41	100.55	96.40	75.42
XXVI	3	17	79.23	negative	81.70	82.49	84.62	29.55
XXVI	3	18[1]	93.37	negative	79.99	281.89	88.37	38.32
XXVI	3	19	78.83	negative	86.21	80.19	79.27	50.86
Average			86.68	–	85.78	92.08	91.10	74.18
Average all previous trials			91.08	–	86.11	124.21	93.56	72.38

[1] Not included in the average.

The average composition and limits of variation of the two lots of gluten feed used in these experiments were as follows: dry matter 90 per cent (87.80–91.22), made up of ash 3.35 (2.52–4.74), protein 27.56 (24.53–29.50), fiber 6.83 (6.31–7.31), nitrogen-free extract 59.16 (56.44–62.52), fat 3.11 (2.08–4.31). The digestion coefficients for gluten feed were secured by applying the coefficients obtained for hay to the amount of hay fed, and deducting the product from the total digestible matter of the basal ration.

The negative results for ash in a majority of the trials are almost always noticed in work with gluten feed. No satisfactory explanation for such results can be given although they may be attributed in part to experimental error due to the small amount of ash present, and in part to the excretion of digested mineral matter from the intestines. In the case of fiber, it will be noticed that occasionally the coefficients were above 100 per cent, due probably to improvement in digestibility of the fiber in the hay as the result of adding a protein concentrate.

Incidentally it may be remarked that as a result of five separate trials with corn bran, the fiber was found to have an average digestibility of 75.12 per cent. This, together with the results secured for the fiber in gluten feed, shows that the fiber in corn is quite well utilized.

The present data, as well as those obtained as a result of many previous trials, show gluten feed to be a highly digestible protein concentrate.

Coffee Refuse.

Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXV	14	15	26.95	97.18	11.48	12.76	32.03	75.36

This material was the residue from the coffee bean, and was being used as a component of a low-grade feed mixture. It contained 93.77 per cent of dry matter, which was composed of ash 5.29, protein 13.29, fiber 33.86, nitrogen-free extract 40.98 and fat 6.58. It was fed in combination with hay and gluten feed to the extent of about 16 per cent of the dry matter of the ration. One sheep refused the mixture, while the other ate it but digested only a small portion. It evidently had very little nutritive value.

Cottonseed Meal.

Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXV	15	12	75.03	95.44	82.57	33.43	82.67	102.75
XXV	15	13	69.54	72.45	81.80	13.35	78.75	93.31
Average			72.29	83.95	82.19	23.39	80.71	98.03
Average all previous trials (14) . . .			79.00	65.00	84.00	32.00	77.00	95.00

The sample contained 92.90 per cent of dry matter, which had 7.40 per cent of ash, 39.35 per cent of protein, and 20.05 per cent of fiber, the latter ingredient being some 8 per cent above the average. It is evident that considerable ground hulls had been added, and the above coefficients show that such an admixture caused the digestibility to be below that for the better grades. As is well known, cottonseed meal is sold on a basis of from 43 to 36 per cent protein; the latter grade results from the addition of ground hulls, which naturally reduces both its feeding and fertilizing value.

Feterita.

Series.	Period.	Sheep.	Dry. Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXVI	10	17	86.71	188.88	86.77	negative	89.73	90.57
XXVI	10	19	86.59	123.08	98.55	negative	89.63	88.61
Average			86.65	155.98	92.66	–	89.68	89.59
Average previous trials (2)			74.65	–	46.55	–	87.94	56.69
Texas Station results[1]			88.99	–	90.03	50.00	96.60	74.52
Corn, for comparison			90.00	–	74.00	57.00	94.00	93.00

[1] Texas Agr. Expt. Sta. Bul. No. 203, p. 32.

Feterita or sudan durra is one of the grain sorghums which include also milo, durra and kaoliang. Two digestion trials were made on another sample a number of years since and reported in Bulletin 181. The present sample analyzed 89.22 per cent of dry matter, which contained ash 1.75, protein 14.46, fiber 1.63, nitrogen-free extract 78.37, and fat 3.8 per cent. In chemical composition it resembles Indian corn, except for its higher protein and lower fat percentage. The present digestion coefficients are quite uniform, and conform fairly well to those secured at the Texas Station. It is evident that feterita is about equal to corn in digestibility. The results secured by us in the former trial, showing 75 per cent of dry matter, 51 per cent of protein and 61 per cent of fat digested, were evidently too low, although they were obtained under satisfactory experimental conditions.

Oat Feed.

Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXIV	12	12	51.30	92.67	81.48	39.03	44.88	118.62
XXIV	12	13[1]	18.94	52.47	4.85	0.83	19.47	101.80
XXV	11	9[1]	28.71	negative	18.28	22.57	30.74	184.69
XXV	11	11[1]	26.88	negative	22.23	20.93	32.20	99.69
XXV	13	9	54.89	25.70	85.57	55.59	49.38	43.28
XXV	13	11	51.46	25.70	89.90	42.79	49.04	46.23
XXV	18	12	56.68	68.79	89.63	57.12	52.37	15.96
XXV	18	13	46.51	23.07	85.95	52.55	39.61	66.57
Average			52.17	47.19	86.51	49.42	47.06	58.13
Timothy hay, for comparison . . .			55.00	39.00	47.00	51.00	62.00	50.00

[1] Not included in the average.

Note. — The average coefficients for ash, fiber, nitrogen-free extract and fat in oat feed, published in Table I (e), p. 120 of Bulletin No. 200, are incorrect. The correct figures are given here.

The value of this material as a food for farm stock was studied by us some two years ago, and the results of the work have been published as Bulletin 200 of this Station. Oat feed, as the term is generally understood by the trade, is a by-product of oatmeal manufacture, and consists of the reground hulls plus the middlings and dust from the first milling of the grain. At some mills the residue from the second milling is also incorporated, but this is not the usual practice.

An average of the analyses of four samples shows the following percentage composition in dry matter: ash 6.48, protein 6.20, fiber 29.18, nitrogen-free extract 55.82, and fat 2.31. It resembles ordinary English hay in composition, except that it contains rather less fiber.

Eight single digestion trials were made with the sheep on this material, four in combination with hay (500 grams hay, 150 grams oat feed), and four with hay and gluten feed (500 grams hay, 150 grams gluten feed, 150 grams oat feed). The results of three of the trials were so much below the others in almost all respects that they are not included in the average. The average of the other five shows a digestibility comparable with timothy hay.

Oat Hulls.

Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXIV	13	9	31.30	15.74	negative	49.64	28.94	negative
XXIV	13	11	36.23	9.46	12.10	51.45	36.13	14.38
Average			33.77	12.60	–	50.55	32.54	–

These coefficients have also been published in Bulletin 200.

The oat hulls contained the following percentages in dry matter: ash 6.37, protein 2.52, fiber 32.66, nitrogen-free extract 57.44, and fat 1.01. Fiber and nitrogen-free extract constitute the larger part of the hulls. The total dry matter is about one-third digestible, which places them among the lowest grades of cereal by-products.

Peanut By-Products.

A study has been made of three peanut by-products, viz., peanut meal, peanut shells and peanut skins. Peanut meal is the ground residue from the extraction of edible oil or soap oil stock. In the former instance it consists of the ground residue from the kernels only, and is specifically known as peanut oil meal. In the manufacture of soap-stock oil the whole peanut is extracted, and the ground residue should be known as peanut feed, a product much inferior to the peanut oil meal, due to the admixture of shell and skin. Peanut shells are the ground or unground outer hull of the nut; while peanut skins are the thin, waxy inner coat of the endosperm or kernel.

Analysis.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Peanut meal	92.33	5.27	39.74	5.09	33.67	16.21
Peanut shells	96.70	3.28	8.91	63.16	18.88	5.77
Peanut skins	94.59	3.46	18.75	8.48	40.01	29.29

Peanut meal, as indicated by the analysis, is a high-grade protein feed with considerably more fat than is contained in most concentrates. The shells are composed of nearly two-thirds fibrous material. The skins contain a reasonable amount of protein and nitrogen-free extract, comparatively little fiber, and a very high percentage of fat.

Coefficients of Digestibility.

(*a*) *Peanut Meal.*

Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXV	19	9	74.62	negative	80.81	59.43	77.59	87.84
XXV	19	11	80.53	5.34	85.47	47.52	84.02	93.94
Average			77.58	-	83.14	53.48	80.81	90.89
German data[1]			83.00	-	90.00	(9)	84.00	90.00

(*b*) *Peanut Skins.*

Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXV	8	11	38.48	negative	49.49	negative	28.80	90.16
XXV	12	15	8.43	34.93	negative	negative	2.70	93.47

(*c*) *Peanut Shells.*

Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXV	16	9	32.83	34.24	69.35	8.63	29.25	83.32
XXV	16	11	25.19	12.61	67.72	.69	55.68	84.83
Average			29.01	23.43	68.54	-	42.47	83.58

[1] Mentzel & Lengerke Landw. Kalender 1922, results of seven single trials with four samples.

While the digestion results with peanut meal are not as high as the average results secured by German observers, the utilization of the protein, nitrogen-free extract and fat, of which it is largely composed, shows that the meal should be placed among the best of the protein feedstuffs.

The digestion results secured with the peanut skins are neither concordant nor very satisfactory. However, in each case they show that the fat, which comprises nearly 30 per cent of the skins, was quite fully utilized. When the skins were fed with hay (period 8), the digestion of the fiber of the ration seemed to be noticeably depressed or interfered with; and when fed with hay and gluten feed (period 12), none of the organic ingredients except the fat was digested. One might therefore conclude that the fat interfered with the utilization of the protein, fiber and nitrogen-free extract. On the basis of the above results, their value as a cattle feed is questionable. In order to utilize them economically, it may be possible to extract the oil and use the residue for litter or for packing purposes.

Peanut shells are shown to have a low digestibility, inferior even to oat hulls. While the small percentage of protein and fat which they contain seems to be well utilized, the fiber which comprises over 60 per cent of the dry matter apparently is little if any digested. The shells, therefore, are of little value as a feed.

Velvet Bean Feed.

Series.	Period.	Sheep.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XXIII . . .	8	12	82.06	41.48	76.64	81.07	89.71	86.69
XXIII . . .	8	13	71.48	28.52	73.96	51.09	81.82	74.41
XXIII . . .	9	9	70.96	22.97	68.56	46.60	80.35	72.79
XXIII . . .	9	11	81.16	33.24	78.02	71.06	86.83	85.63
Average			76.42	31.55	74.29	62.46	84.68	79.88
Wheat bran, for comparison			66.00	–	77.00	39.00	71.00	63.00

Velvet bean feed consists of the ground seed and pod of the velvet bean, a rank-growing tropical legume which is cultivated extensively in Florida, Alabama and Mississippi. It has appeared at different times in Massachusetts, and a full report on its merits may be found in Bulletin 197.

Its composition on a dry matter basis is as follows: dry matter 88.16, ash 5.79, protein 18.94, fiber 14.50, nitrogen-free extract 56.16, fat 4.62. It resembles wheat bran in composition, but has slightly more protein and considerably more fiber, due to the presence of the pods. The average of the four trials shows about the same amount of digestible protein as is found in wheat bran. The fiber, nitrogen-free extract and fat are, however, somewhat more digestible, and on the basis of total digestible nutrients the velvet bean feed has about 11.5 per cent greater feeding value than bran.

Summary.

In the table following, the average composition of each feeding stuff is given, together with the average coefficients of digestibility and the limits of error, calculated by Bessel's formula. The error limit is large in some cases, the cause therefor being explained in the discussion of results on pages 53-61. In case of oat hulls and peanut shells the results vary so widely that the limits of error are not stated. The coefficients indicate that much difficulty was experienced in digesting these materials and that they possessed comparatively little nutritive value. The coefficients for the ash in all cases are of uncertain value because it is now recognized that a considerable portion of the digested mineral matter is excreted through the feces, whereas in case of organic nutrients the end products of digestion are eliminated through the lungs, skin and urine. Where the percentage of fat in the feed is small — 1 per cent or less — the coefficients have little meaning.

Composition and Coefficients of Digestibility of Feeding Stuffs.

Feedstuff.	Number of Tests.	Number of Animals.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
English Hay, composition	–	–	89.67	6.07	7.95	33.81	49.52	2.65
Coefficients, lot 1	2	2	58.40±0.33	45.37± 0.14	47.81±0.31	62.67±0.52	59.98±0.21	45.44
Coefficients, lot 2	8	7	56.98±0.82	36.99± 2.29	46.52±0.98	64.70±0.66	55.92±1.08	31.01± 1.79
Coefficients, lot 3	9	9	60.55±0.53	33.32± 1.60	56.13±0.70	65.86±0.51	61.72±0.53	46.25± 0.81
Average coefficients	19	9	58.82±0.49	36.13± 1.32	51.21±0.90	65.03±0.39	59.09±0.66	39.75± 1.42
Gluten Feed, composition	–	–	90.00	3.35	27.56	6.83	59.16	3.11
Coefficients	9	6	86.68±1.54	–	85.78±0.81	92.08±2.44	91.10±1.83	74.18± 4.68
Dried Apple Pomace, composition	–	–	94.70	1.55	5.88	19.22	68.64	4.71
Unground, coefficients	4	4	65.61±1.77	–	–	73.10±3.62	74.93±1.13	37.16±2.25
Ground, coefficients	3	3	71.44±2.25	–	–	63.65±5.73	77.57±2.16	34.58± 3.26
Both lots, coefficients	7	4	68.11±1.50	–	–	69.05±3.18	76.06±1.08	36.05± 1.76
Barley Screenings, composition	–	–	89.73	6.30	9.98	19.51	61.08	3.13
Coefficients	2	2	57.45±2.12	22.51± 4.91	73.92±5.94	38.45±2.83	62.14±1.25	9.48± 0.33
Carrots, composition	–	–	12.00	9.91	8.92	8.33	71.61	1.23
With hay, coefficients	3	2	77.31±1.23	11.75± 2.52	72.06±3.78	64.83±3.66	92.16±1.03	67.62± 2.79
With hay and gluten feed, coefficients	4	2	80.31±1.64	42.94± 3.08	56.40±1.57	105.27±8.84	89.60±1.24	16.78± 4.90
Coffee Refuse, composition	–	–	93.77	5.29	13.29	33.86	40.98	6.58
Coefficients	1	1	26.95	97.18	11.48	12.76	32.03	75.36
Cottonseed Meal, composition	–	–	92.90	7.40	39.35	20.05	25.33	7.87
Coefficients	2	2	72.29±1.85	83.95± 7.75	82.19±0.26	23.29±6.77	80.71±1.32	98.03± 3.18
Feterita, composition	–	–	89.22	1.75	14.46	1.63	78.37	3.80
Coefficients	2	2	86.65±0.04	155.98±22.19	92.66±3.97	–	89.63±0.03	89.59± 0.66
Oat Feed, composition	–	–	93.11	6.48	6.20	29.18	55.82	2.31
Coefficients	5	4	52.17±1.18	47.19± 9.59	86.51±1.04	49.42±2.43	47.06±1.49	58.13±11.56
Oat Hulls, composition	–	–	91.75	6.37	2.52	32.66	57.44	1.01
Coefficients	2	2	33.77	12.60	–	50.55	32.54	–
Peanut Meal, composition	–	–	92.33	5.27	39.74	5.09	33.67	16.21
Coefficients	2	2	77.58±1.99	–	83.14±1.57	53.48±4.02	80.81±2.17	90.89±2.06
Peanut Shells, composition	–	–	96.70	3.28	8.91	63.16	18.88	5.77
Coefficients	2	2	29.01	23.43	68.54	–	42.47	83.58
Velvet Bean Feed, composition	–	–	88.16	5.79	18.94	14.50	56.16	4.62
Coefficients	4	4	76.42±2.03	31.55± 2.64	74.29±1.41	62.46±5.51	84.68±1.47	79.88± 2.46

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THE VALUE OF BUTTERMILK AND LACTIC ACID IN PIG FEEDING

By J. B. LINDSEY and C. L. BEALS

Condensed (semi-solid) and dried buttermilk are by-products of the creamery industry, now widely advertised for use in pig feeding. An experiment with twelve growing pigs showed that condensed (semi-solid) and dried buttermilk when fed in limited amounts proved altogether too expensive to warrant their use for economical pork production. The semi-solid milk cost six cents and the dried article twelve cents a pound, and they were fed in the diluted form to the extent of from two to four quarts daily per pig.

Two experiments with lactic acid added to the grain slop in the amounts usually found in ordinary buttermilk showed no pronounced effect in promoting appetite or in causing an increase of growth.

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BULLETIN No. 217.

DEPARTMENT OF CHEMISTRY.

THE VALUE OF BUTTERMILK AND LACTIC ACID IN PIG FEEDING.

BY J. B. LINDSEY AND C. L. BEALS.

Condensed and Dried Buttermilk as a Food for Pigs.

Buttermilk, as it comes from the creamery, has long been recognized as a valuable food for growing pigs and poultry. Some thirty-five years ago, the late Professor Goessmann of this Station showed that on the basis of total solid ingredients (dry matter), buttermilk and skim milk when fed to growing pigs possessed substantially equal values.

At the present time neither by-product is obtainable in regular supply in most sections of Massachusetts at prices which warrant its use, especially for pigs. In recent years buttermilk, from which a portion of the water has been removed by the use of a partial vacuum and which is of a pasty consistency, has been placed upon the market under the trade name of semi-solid buttermilk,[1] and offered at from five and one-half to six cents per pound in barrel lots. It is also put up in fifty-pound wooden pails, intended particularly for poultry. A completely dried buttermilk, of a creamy color and of a powdered or flaky appearance, is also to be had, costing from ten to twelve cents a pound.

Inasmuch as the condensed or "semi-solid" material is freely advertisèd and its use recommended and urged, it seemed worth while to test its economy by feeding it in limited amounts to two groups of pigs. The dried buttermilk was also similarly tried.[2]

Chemical Composition.

Material.	Water.	Ash.	Protein.	Lactic Acid.	Milk Sugar.	Fat.
"Semi-solid" buttermilk	67.63	3.25	12.43	7.02	8.77	.90
"Semi-solid" buttermilk	67.06	–	–	–	–	–
Dried buttermilk	6.64	8.29	32.71	–	51.91[3]	.75
Liquid buttermilk	91.60	0.70	3.60	–	5.00[3]	.10–.27
Skim milk,[4] for comparison	90.10	0.70	3.80	–	5.20	.20

[1] The Universal Products Sales Co., 165 Liberty St., New York, are wholesale distributors.

[2] Sample secured from the Merrell-Soule Co., Syracuse, N. Y. The Collis Products Co., of Clinton, Iowa, claim to be large manufacturers of dried buttermilk and offer it in paper-lined sax at $9.50 a cwt. delivered, or $10 a cwt. in barrels. The price, naturally, is subject to change.

[3] Including lactic acid.

[4] Centrifugal process of separation.

mixture of one-third each of corn meal, wheat middlings and ground oats to satisfy appetites. This was continued until the end of the trial. This ration, with its variations, was considered a standard or check ration suitable for promoting normal growth.

Lot II. — The same corn meal, middlings, oats and tankage mixture fed to Lot I. This was fed throughout the trial in the proportion of 9 ounces to each quart of water containing .7 per cent of lactic acid. Milk was omitted from the ration.

Food Consumed and Growth Produced (Pounds).

	Lot I. Pigs 1 and 2.	Lot II. Pigs 3 and 4.
Number of days in trial	116	116
	Pounds.	Pounds.
Dry Matter in food consumed:		
Skim milk[1]	199.0	none
Corn meal	336.4	164.0
Wheat middlings	140.2	167.0
Ground oats	140.2	167.0
Digester tankage	4.8	76.0
Lactic Acid[2]	none	18.0
Total	820.6	592.0
Growth Produced:		
Weight at beginning	35 26	28 29
Weight at end	165 175	122 120
Total gain	130 149	94 91
Daily gain	1.12 1.28	.81 .78
Dry Matter per 100 pounds Gain	294.1	320.0

[1] Pigs 1 and 2 received 1,028 quarts of skim milk averaging 9 per cent solids. One quart was taken to equal 2.15 pounds.

[2] Pigs 3 and 4 received 1,224 quarts of water containing .7 per cent lactic acid. One quart was taken to equal 2.1 pounds.

A glance at the above table shows that Lot I, which received considerable skim milk in addition to the grain mixture, made a satisfactory growth. This may be attributed, in part at least, to the ease of digestion and assimilation of the milk, to the extra dry matter consumed, to the favorable proteins and also to the vitamin content of the milk. Lot II grew fairly well, but the pigs were not equal to Lot I because of the absence of the skim milk. The lactic acid did not seem to be helpful in growth production.

Trial II, September 22–December 1.

Six grade Chester White pigs were procured in September and fed upon skim milk and corn meal until each weighed between 20 and 30 pounds. They were then divided into three lots of two each and fed as follows:

Lot I. — Eight ounces of the following mixture to each quart of water, in amounts to satisfy the appetite:

30 pounds Corn meal.
30 pounds Wheat middlings.
30 pounds Ground Oats.
10 pounds Digester tankage.

Lot II. — The same grain mixture as Lot I, with sufficient lactic acid added to the water so that it tested .4 per cent of that ingredient.

Lot III. — The same grain mixture as Lots I and II, with sufficient lactic acid to make the solution test .8 per cent of that ingredient.

The experiment began September 22 and ended December 1, proceeding without any disturbances. The weighing, housing and general care of the pigs were the same as in the preceding experiments. For the first two weeks of the experiment, after the change was made from the corn meal and skim milk to the experimental diet, none of the pigs made much growth; but as soon as they adapted themselves to the new diet a reasonable growth was noted from week to week.

Dry Matter in Food Consumed and Growth Produced (Pounds).

	Lot I. Pigs 1 and 2.	Lot II. Pigs 3 and 4.	Lot III. Pigs 5 and 6.
Number of days in trial	70	70	70
	Pounds.	Pounds.	Pounds.
Dry Matter in food consumed:			
Corn meal	79.4	77.8	79.4
Wheat middlings	80.2	78.6	80.2
Ground oats	80.8	79.2	80.8
Digester tankage	27.2	26.8	27.2
Lactic acid	none	5.0[1]	10.4[2]
Total	267.6	266.2	278.0
Growth Produced:			
Weight at beginning	29 28	21 21	25 23
Weight at end	67 66	62 57	60 65
Total gain	38 38	41 36	35 42
Average daily gain	.54 .54	.59 .51	.50 .60
Dry Matter per 100 pounds Gain	351.3	345.7	361.0

[1] Pigs 3 and 4 received a total of 604 quarts each of water containing .4 per cent lactic acid, 2.1 pounds per quart.

[2] Pigs 5 and 6 received a total of 616 quarts each of water containing .8 per cent lactic acid, 2.1 pounds per quart.

From the general appearance of the pigs, and from the above data, one is justified in concluding, in case of both trials, that the lactic acid was without any pronounced effect in promoting growth. It is possible that lactic acid may have some therapeutic effect in case of animals undergoing digestive disturbances, but under normal conditions its use is not advised.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION

BULLETIN No. 218 OCTOBER, 1923

THE

CONTROL OF THE SQUASH VINE BORER IN MASSACHUSETTS

By HARLAN N. WORTHLEY

The squash vine borer is a widely distributed and very serious enemy of squashes and related plants. Because of the protected life of the larva, which burrows within the squash stem, insecticides have been considered useless in the control of this pest. The best direct remedy has been to cut the borers from infested vines, a tedious and impractical treatment in commercial plantings.

This bulletin reports the discovery and application of a spraying program for squash vine borer control which has given satisfactory results under Massachusetts conditions, and which kills the insect in the egg stage, thus protecting the plants against the slightest injury from borers.

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AGRICULTURAL EXPERIMENT STATION

AMHERST, MASS.

THE CONTROL OF THE SQUASH VINE BORER IN MASSACHUSETTS.

By HARLAN N. WORTHLEY.

Distribution and Importance.

The squash vine borer[1] is a native of the New World, and apparently is of tropical origin. It has spread northward over that portion of the United States east of the Rocky Mountains, and into Southern Canada. It is found as far south as Argentina.

In many localities the squash vine borer is the most serious enemy of winter squashes. Pumpkins and summer squashes are also affected, and more rarely melons and cucumbers.

Description.

Egg. — The egg of the squash vine borer is shown in Plate I, figure 1 and Plate II, figure 2. It is about one-twenty-fifth of an inch in length, and is of a dark reddish brown color. As may be seen in Figure 1, the eggs are not laid in clusters, as in the case of squash bug eggs, but singly. Magnification, as in Plate II, figure 2, shows the chorion to be finely reticulated into tiny hexagonal figures.

Larva. — The larva, or "borer" (Plate I, figure 1 & Plate II, figure 3) as it is commonly called, is a fleshy, white, nearly hairless caterpillar with a black head and a dark brown to black thoracic shield. When full grown it measures about an inch in length. Newly-hatched larvae, which are commonly not detected in the field, are about one-sixteenth of an inch long, sparsely covered with hairs, and with a broad black head, from which the white body tapers away to the anal extremity. In appearance the borer is quite distinct from the larva of the striped cucumber beetle, with which, however, it is often confused. The latter is but three-tenths of an inch long and is very slender, with the head and anal plate dark brown.

Pupa. — The pupa (Plate I, figure 1) is contained in an earth-covered cocoon of very tough, black silk about three-fourths of an inch long. The pupa itself is about five-eighths of an inch long, and is of a dark shining brown color. The head bears a horn-like process between the eyes, and the abdomen bears circles of hook-like spines.

Adult. — The adult moth (Plate I, figure 1) is five-eighths of an inch or more in length, with a wing spread of an inch to an inch and a half. It is strikingly beautiful, with long narrow olive green fore wings, bearing a fringe of blackish hairs at the tips. The hind wings are transparent, bearing scales only along the veins. The abdomen is covered with red or orange scales, and is marked with transverse white lines and a longitudinal row of black or bronze-colored spots. The tarsi are banded with white, and the hind legs are covered with long black, white, and orange-colored hairs. The sexes are quite similar, the male being more brilliantly marked than the female, and with a narrower abdomen.

Life History and Habits.

The squash vine borer passes the winter as a full-grown larva. It is enclosed in the tough silken cocoon which it spins in the soil of squash fields, at a depth of from one to six inches below the surface of the ground. Pupation occurs within this cocoon in the spring, and lasts about three weeks. At the end of this time the pupa cuts through one end of the cocoon by means of the horn-like process on its head, and wriggles to the surface of the ground, being aided in this endeavor by the circles of spines around its abdomen. When it projects above the ground about three-fourths its length, motion ceases, and very shortly the pupal skin splits back

[1] *Melittia satyriniformis* Hübner (Lepidoptera, Ægeriidæ).

PLATE I.

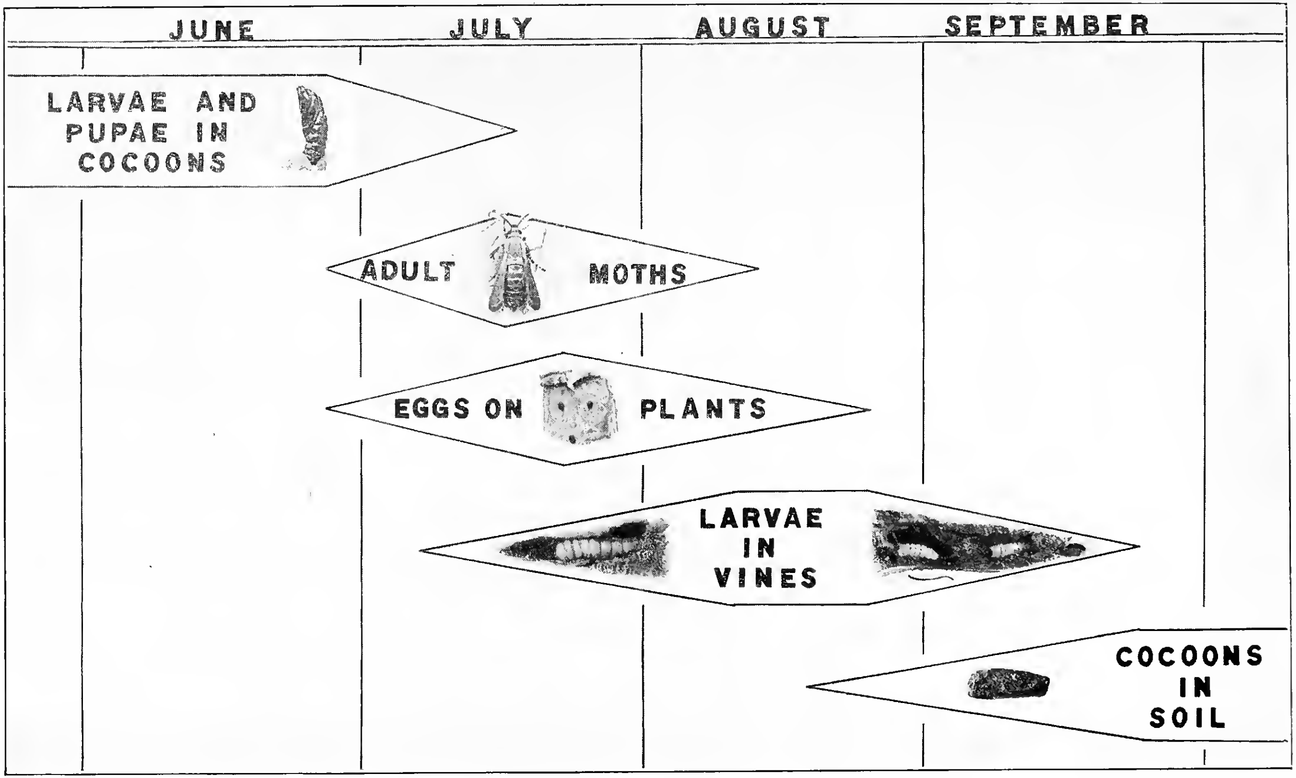

FIG. 1. Seasonal History of the Squash Vine Borer at Amherst.

from the head and the adult moth slowly drags itself forth. The emergence occupies in the neighborhood of five minutes, when the freed moth climbs upon some nearby object to expand and dry its wings in readiness for flight, which can be accomplished in a matter of fifteen minutes following emergence.

Plate I, figure 1, is a record of continuous observations from 1920 to 1923, and indicates an average seasonal occurrence of the different life stages of the insect at Amherst, and the average period of greatest abundance. The moths are present in numbers from the last of June until the first week in August. They dart from plant to plant in the heat of the day, and their rapidly vibrating wings and brilliant coloration cause them to be easily mistaken for wasps. They are fairly strong flyers, and the writer has known them to locate squash fields removed one-half mile from where cucurbits were grown the previous year.

The female moths lay their eggs singly, going from hill to hill, depositing one to several eggs on each plant. The eggs are attached by the flattened base, and are held in place by a cement-like secretion. Individual moths seem to have different tastes regarding the location selected for the eggs. In following moths from hill to hill, some are observed to seek the junction of the stem and the ground, some oviposit upon the leaf-stalks, and some even tuck the eggs down between the squash stem and the surrounding soil. Other moths lay their eggs indiscriminately upon main stem, leaves, leaf-stalks, and even upon tendrils and blossoms. The favorite location, however, appears to be the main stem near the base. Several counts have been made to determine the percentage of the total number of eggs laid on the different parts of the plant. The data are presented in Table I.

TABLE I. — *Location of Squash Vine Borer Eggs.*

	On Stem.	On Leaf-stalks.	On Leaves.	Total.
Lexington, 1922	377	299	10	686
Amherst, 1922	168	48	0	216
Littleton, 1923	48	5	7	60
Amherst, 1923	426	36	23	485
Total	1,019	388	40	1,447
Per cent of total	70.4	26.8	2.8	

Individual moths may lay as many as one hundred fifty to two hundred eggs. Theoretically, therefore, ten moths only, flying from plant to plant and each laying a total of one hundred fifty eggs, are necessary to cause a one hundred per cent infestation of fifteen hundred plants, which is perhaps the average number of plants per acre.

Eggs are to be found from late June or early July until mid-August, and even later in some seasons. The period spent in the egg stage has been placed by various investigators at from six to fifteen days. Breeding records at Amherst show a variation of from nine to thirteen days, but they are not extensive and may not represent the extremes for this climate.

TABLE II. — *Length of Egg Stage, Amherst.*

Number of Eggs.	Eggs laid.	Eggs hatched.	Number of Days.
10	July 29, 1920	Aug. 11, 1920	13
4	Aug. 4, 1923	Aug. 13, 1923	9
1	Aug. 5, 1923	Aug. 14, 1923	9

The records are those obtained from eggs laid by confined moths. Eggs collected in the field showed a high percentage of parasitism, which is discussed in another section of this paper, and were quite unsatisfactory for rearing.

When emerging from the egg, the young larva chews a ragged hole in one end and crawls forth upon the surface of the squash plant. Its subsequent action shows considerable variation in habit. In many cases it burrows directly into the host tissue. In other instances newly-hatched larvae have been seen to crawl to distances of eight to ten inches from the egg-shell, feeding here and there on the leaf or stalk before finally tunneling out of sight. Those which invade the leaf-stalks and main leaf veins gradually work their way toward the main stem. Since the average squash plant has not put forth runners when the majority of the eggs have been laid, the result of this movement is a concentration of injury in the main stem near the base.

The burrow made by the squash vine borer larva is a twisting one, and is frequently obstructed by a webbing of silk mixed with yellowish grains of excrement, called "frass". The greater part of the frass is pushed out through holes in the stem, where it clings in moist masses, serving to indicate the position of the borer within. The popular opinion seems to be that borers penetrate directly to the central cavity of the main stem along which they work, feeding at the walls of this cavity. This is not strictly the case. The larvae usually work in the tissue surrounding the central cavity of the stem, and often do not break through into this cavity until they are about half grown.

One borer can usually find food for its complete development at the base of the stem. When more borers are present, however, the mining is extended along the main stem and runners, into the bases of the leaf-stalks and, in rare instances, even into the fruit itself. Upon the death of one plant, the larvae are able to transfer their activities to one nearby.

Growth is completed in a month to six weeks, at the end of which time the full-grown caterpillar deserts its burrow in the squash plant and enters the soil nearby. After penetrating to a depth of from one to six inches it hollows out a cell, spins its cocoon of tough black silk and, gradually shrinking within its last larval skin, settles down to pass the winter.

There is but one generation of the squash vine borer each year in New England. It is partially double-brooded, however, in the latitude of New Jersey and Southern Ohio, and two full generations occur in Georgia and further south.

Nature of Injury.

In late July in Massachusetts, squash growers begin to notice plants with wilted, drooping leaves. This condition may be a result of excessive feeding in the root by larvae of the striped cucumber beetle. It is also a symptom of the disease known as bacterial wilt. The chief cause of this wilting, however, is found in the gradual destruction of the main stem of the squash plant near its base by the tunneling of squash vine borer larvae, which may be detected by the yellowish masses of frass which they push from their burrows.

The base of the main stem frequently fails to support all the borers present, and becomes a filthy, rotting mass, invaded by various sap-feeding beetles and filth-loving insects. See Plate II, figure 4. It is finally reduced to a few dried shreds, separated from the root by a light pull. See Plate II, figure 5.

The effect of squash vine borer infestation varies from a slight check in the growth and productiveness of the infested vine, to its death outright, and the loss of its partly-formed fruit. In the same field one may see a well-grown, thrifty vine which shows some borer injury, and nearby a dried, withered remnant of a vine, the shredded and distorted base and hardened masses of frass testifying to the cause of its death. A combination of factors is involved in this difference in the effect of infestation. First, a thrifty vine can often support one or two borers, while a less vigorous plant will be completely girdled. Second, plants which have been girdled do not always die. If the runners have developed far enough to "strike" numerous secondary roots from the nodes, and if these roots can find sufficient moisture and food, the vine may yet produce a fair crop. The crop is materially

PLATE II.

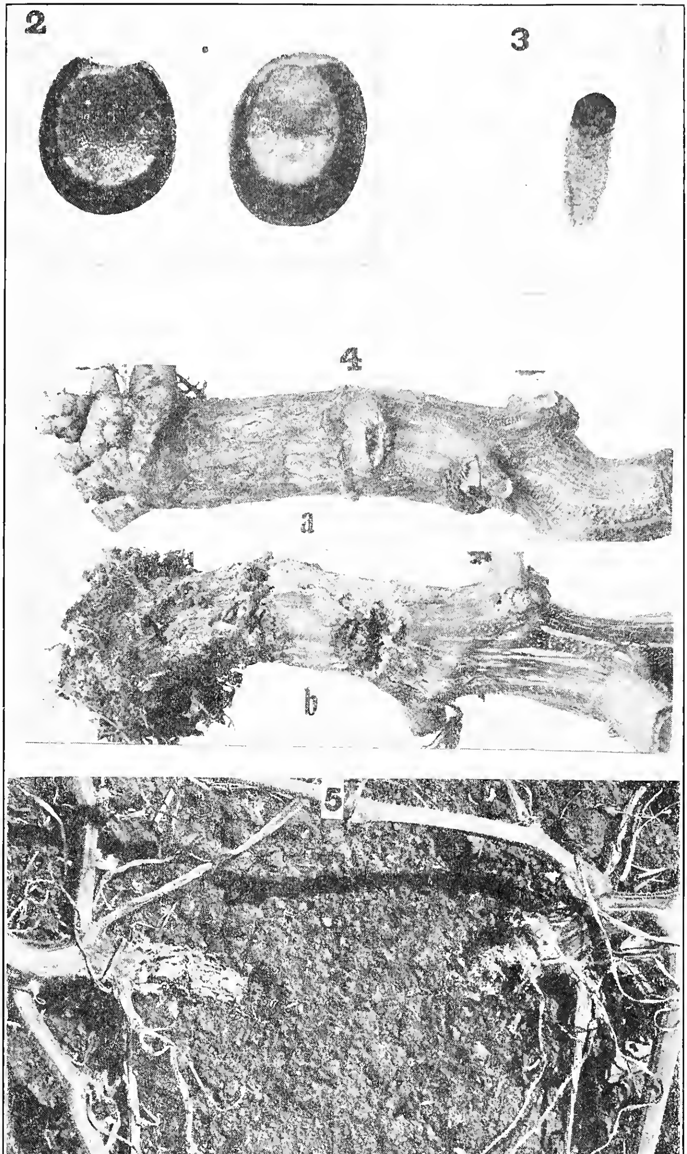

FIG. 2. Photomicrograph of squash vine borer eggs, x 24 (original).

FIG. 3. Newly hatched squash vine borer larva. Photomicrograph, x 13 (original).

FIG. 4. *a*. Healthy squash stem. *b*. Badly infested squash stem. Note burrows at "X." (Photo by R. L. Coffin.)

FIG. 5. Center of badly infested hill of squash. Note shredded condition of the bases of the stems. (Photo by R. L. Coffin.)

reduced, however, if not lost entirely in dry portions of the field or in dry years, or when fertilization of a naturally poor soil has been confined to the hill, as is so often the case. In the case of squashes planted late, or having a slow early growth, in which the runners have failed to root before the borers become half grown, the crop is very often a failure.

Natural Enemies.

No parasitic enemies of the adult moth have yet been recorded. It is the chance prey, however, of certain large robber flies (Asilidae) which have been observed to pounce upon the moths in the fields. The larvae in their tunnels in the squash stem appear to have escaped parasites, but are sometimes attacked by the larvae and adults of ground beetles (Carabidae). These agencies are of little economic importance.

The eggs of the squash vine borer are subject to a high degree of parasitism by a tiny wasp of the family Scelionidae, the members of which are exclusively egg parasites. The species has been identified by Mr. A. B. Gahan, of the United States National Museum, as *Telenomus* (*Prophanurus*) sp. The extent of the work of this tiny benefactor is evident from the following records of rearings.

Table III. — *Parasitism of Squash Vine Borer Eggs.*

Date.	Eggs.	Parasites.	Per Cent of Parasitism.
1920			
July 24	11	11	100
July 31	20	9	45
1922			
July 7	6	2	33.3
July 28	8	1	12.5
1923			
July 16	52	40	77

Control.

Cultural and Hand Methods.

Insecticides have heretofore been considered useless in the control of the squash vine borer, and consequently many cultural practises and hand methods have been advanced for the purpose of lessening the severity of the attack. A few of these are applicable under Massachusetts conditions, and are here discussed.

Trap Crops. — Winter squash, summer squash, pumpkins, melons, and cucumbers seem to be visited in the above order of preference by the egg-laying moths. Plantings of winter squash or summer crooknecks may draw the moths away from other cucurbits, and when used for this purpose should then be destroyed before the borers in them become full grown.

Fall Plowing. — Although many larvae doubtless penetrate below the plow line before spinning their cocoons, others are turned up, crushed, or exposed to the winter weather when squash fields are plowed in the fall following the removal of the crop.

Fertilization. — Many farmers seek to grow squashes on poor land with no application of fertilizer except in the hill. Borer damage is sometimes greatly enhanced by this practise. A note made by the writer in 1920 shows the effect of adequate fertilization, and is here quoted:

The history of the squash crop this year is a good illustration of the effect of proper preparation of the land and care of the crop during early growth in offsetting the attack of the squash vine borer. The experimental plot was a sandy loam. In the spring a thirty-inch stand of rye had been plowed under. Lime was applied at the rate of three thousand pounds per acre, and a 4–8–4 fertilizer at the rate of fifteen hundred pounds

per acre. At planting, double furrows were opened up ten feet apart, and a good big forkful of manure was dropped every eight feet in the furrows. Over this manure, the seeds were planted. From the time the plants appeared until the runners closed the spaces between the rows, the ground was kept mellow by frequent cultivation. Before the plants started to run they were thinned to two plants in each hill. High fertilization and mellowness of soil promoted vigorous growth and the formation of secondary roots from the nodes of the runners. This formation of secondary roots was favored also by the unusually even distribution of rainfall throughout the summer. The importance of these secondary roots can be judged by the fact that every plant in the field was infested with borers, and the great majority suffered a complete rotting off of the main stem as a result. In spite of this, the harvest of squashes was declared to be satisfactory.

Covering the Runners. — Some growers make it a practise to insure the "striking" of secondary roots by covering the runners with earth at about a foot from the base of the plant. Fertilizer is sometimes added at these points. This practise is a useful one, and often serves to reduce materially the amount of damage done by the borers.

Cutting out the Borers. — The practises mentioned above, while they often aid in mitigating the severity of the squash vine borer attack, have no direct effect upon the borer itself. The best method heretofore practised for actually killing the borers has been the custom of cutting them from the vines. Slitting the stem lengthwise in both directions from the frass-clogged hole and bending back the cut portion will usually reveal the borer, which can then be removed and killed. If the stem is subsequently covered with earth, the operation will have little injurious effect upon the plant. By constant watchfulness from the middle of July to the first of September, a few plants in a home garden can be protected from excessive borer injury by this means.

The Use of Insecticides.

Certain insecticides have been tried in the past against the squash vine borer, and have been declared valueless. Among these were arsenate of lead painted thickly on the squash stems, and wrappings of tarred paper. Injections of various toxic substances have been tried at this station, but without success, both because of the nature of the burrows and of the webbing of silk and frass which obstructs them. Studies of the life history and habits of the species in 1920 led to spraying experiments in 1921 with the following materials: —

Material.	*Possible Action.*
Arsenate of lead powder, 3 pounds in 50 gals. water.	Poisoning of newly-hatched larvae.
Nicotine sulfate (Black-leaf "40"), 1 part in 100 parts of water.	Penetration and killing of the eggs — repelling of adult moths.
Bordeaux mixture, 4–4–50 formula.	Repelling of adults.

Preliminary experiments with these materials were conducted in 1921 and 1922 leading up to the successful field applications of 1923. On the basis of this work, the following sprays were applied in 1923: —

Material.	*Action of Spray.*
Black-leaf "40", 1–100, 1–250, and 1–500.	Toxic to eggs.
Arsenate of lead powder, 2 pounds in 50 gals. water; 3 pounds in 50 gals. water, plus "Kayso" sticker.	Poisons newly-hatched larvae as they chew at surface of squash plant.

The work was done on a commercial scale at Littleton, in coöperation with a squash grower, and at the Agricultural Experiment Station at Amherst. It is here reported in some detail.

The Littleton Experiment. — Mr. Homer Richards, a truck gardener and orchardist living in Littleton, offered the use of a one-acre field of winter squashes and, in addition, his assistance in the application of the sprays. The field contained twenty rows planted fifteen feet apart, and twenty-five hills six feet apart in each row. Plots were marked off as follows: —

Rows.	Treatment.	Rows.	Treatment.
1-2	Check	13-14	Check
3-6	Black Leaf "40", 1-500	15-18	Black Leaf "40", 1-100
7-8	Check	19-20	Check
9-12	Lead Arsenate, 2.5-50		

Four applications were made: on July 5, July 12, July 19, and July 26. Compressed air sprayers of three-gallon capacity were used for the first three applications. Each was fitted with a short spray rod and a 45° angle disc nozzle, pictured in figure 1. All portions of the plants were thoroughly sprayed, particular attention being paid to the base of the stem. The fourth application was made with a power sprayer and one lead of hose bearing the short spray rod and angle nozzle. A pressure of 100 to 125 pounds per square inch was maintained.

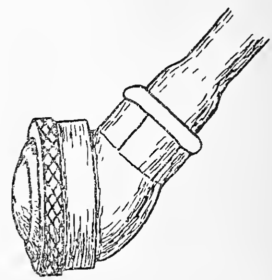

Fig. 1. 45° Angle-disc Nozzle Used in the Experiments.

Examinations to check the progress of the infestation and the effect of the treatment were made by the writer on each trip to Littleton. On July 13, a count of eggs on about twenty-five plants in each treatment gave the following results: —

Table IV. — *Squash Vine Eggs at Littleton, July 13, 1923.*

Treatment.	Eggs per Plant.
Check	1.04
Black Leaf "40", 1-500	.77
Lead Arsenate, 2.5-50	.94
Black Leaf "40", 1-100	.80

The difference in number of eggs exhibited by the check and treated plots is attributed to the mechanical effect of the spray in knocking some eggs from the plants. The writer has noticed frequently that while some eggs are firmly attached to the plants, others may be dislodged at a touch. The difference exhibited between the lead arsenate treatment and the Black-leaf "40" is attributed to a possible slight repellent effect of the nicotine sprays, the odor of which can be detected on the vines for about twenty-four hours following their application.

The effectiveness of the treatments was determined by counts of the number of borers and number of plants in treated and check plots. The final count was made on August 13 and 14, at which time the oldest larvae were ready to leave the vines, and the youngest ones were large enough to make their presence known. Every plant in the experimental field was carefully examined for borer injury, and the number of plants and number of borers in each hill recorded. The detailed results of this count are given in Table V. A summary of these counts, translated into borers per thousand plants, is also given.

TABLE V. — *Effectiveness of Treatments, Littleton, 1923.*

TREATMENT.	Rows.	Number of Plants.	Number of Hills.	Number of Infested Hills.	Number of Borers.
Check	1-2	221	50	50	326
Black-leaf "40", 1-500	3-6	387	100	81	162
Check	7-8	187	50	50	148
Lead arsenate, 2.5-50	9-12	335	100	69	130
Check	13-14	132	50	46	134
Black-leaf "40", 1-100	15-18	375	100	18	18
Check	19-20	159	50	47	126

Summary

MATERIAL.	BORERS PER THOUSAND PLANTS.		Per Cent of Control.
	Check.	Treated.	
B. L. "40", 1-100	910	48	94.8
B. L. "40", 1-500	1,138	420	63.1
Lead arsenate, 2.5-50	909	388	57.4

The Amherst Experiment. — The experimental field at the Massachusetts Agricultural Experiment Station contained twenty-eight rows, twelve feet apart, with nine hills, eight feet apart in each row. Each treatment was applied to each of three separate plots, and each treated plot was flanked by a check plot with which its infestation was compared. The plan was as follows: —

Rows.	Treatment.	Rows.	Treatment.
1-2	Check	15-16	Black Leaf "40", 1-250
3-4	Black Leaf "40", 1-100	17-18	Lead Arsenate, 3-50
5-6	Black Leaf "40", 1-250	19-20	Check
7-8	Check	21-22	Black Leaf "40", 1-100
9-10	Lead Arsenate, 3-50	23-24	Black Leaf "40", 1-250
11-12	Black Leaf "40", 1-100	25-26	Check
13-14	Check	27-28	Lead Arsenate, 3-50

Four applications were made: on July 7, July 17, July 23, and August 2. The first application was made with a compressed air sprayer, and the other three with a power outfit. Before the last application it was found necessary to move some runners from the path of the spray rig as it passed between the rows.

On July 24, a count of eggs and larvae present in the different plots gave the following results: —

TABLE VI. — *Status of Infestation, Amherst, July 24, 1923.*

TREATMENT.	Eggs per 100 Plants.	Eggs already Hatched.
Check	41	17+
Black Leaf "40", 1-100	16	0
Black Leaf "40", 1-250	19	0
Lead Arsenate, 3-50	16	3+

The difference in the number of eggs found in the checks and in the treated plots is greater here than at Littleton (see Table IV). This difference is doubtless due to the greater force with which the spray stream is applied with a power sprayer than with a compressed air sprayer. It seems clear that the difference is due to the mechanical action of the spray stream in knocking eggs from the plants rather than to any marked repellent qualities of the spray materials themselves. Lead arsenate has not been demonstrated to be repellent to insects, and yet no more eggs were found in the plot sprayed with this material than in the plots treated with the nicotine sprays. In view of this fact, it is impossible to attribute definite repellent qualities to the Black-leaf "40", in this connection.

The number of larvae found compared with the number of eggs present, as expressed in the last column of the table, indicates the toxic effect of the spray materials. The counts in the check plots may be taken as a normal progression of development of the eggs. The counts in the plot treated with lead arsenate indicate a kill of about 50 per cent, while those in the plots treated with both strengths of Black-leaf "40" indicate 100 per cent control.

The final count was made on August 20 and 21. The detailed results are recorded in Table VII, and are summarized below.

Table VII. — *Effectiveness of Treatments, Amherst, 1923.*

Treatment.	Rows.	Number of Plants.	Number of Hills.	Number of Infested Hills.	Number of Borers.
Check	1-2	65	16	13	33
Black-leaf "40", 1-100	3-4	61	18	2	2
Black-leaf "40", 1-250	5-6	69	18	7	9
Check	7-8	82	18	18	82
Lead arsenate, 3-50	9-10	70	18	10	19
Black-leaf "40", 1-100	11-12	55	18	0	0
Check	13-14	39	17	16	32
Black-leaf "40", 1-250	15-16	69	18	3	3
Lead arsenate, 3-50	17-18	63	18	7	10
Check	19-20	61	18	17	58
Black-leaf "40", 1-100	21-22	69	18	0	0
Black-leaf "40", 1-250	23-24	76	18	7	8
Check	25-26	66	17	14	36
Lead arsenate, 3-50	27-28	54	18	7	12

Summary.

Black-leaf "40", 1-100.	Borers per Thousand Plants.		Per Cent of Control.
	Check.	Treated.	
Rows 3-4	481	33	93.2
Rows 11-12	837	0	100.0
Rows 21-22	953	0	100.0
Average	757	11	97.7

Black-leaf "40", 1-250.	Borers per Thousand Plants.		Per Cent of Control.
	Check.	Treated.	
Rows 5-6	995	131	86.9
Rows 15-16	837	43	94.9
Rows 23-24	547	53	90.4
Average	793	76	90.5

Summary — Concluded.

Lead Arsenate, 3-50.	Borers per Thousand Plants.		Per Cent of Control.
	Check.	Treated.	
Rows 9-10	995	280	71.9
Rows 17-18	953	159	83.4
Rows 27-28	547	223	59.3
Average	832	221	73.5

The high degree of effectiveness exhibited by Black-leaf "40" at the above dilutions is undoubtedly due to its ovicidal action, since, as shown in Tables VI and VII, eggs were found in the plots treated with these materials in great excess of the numbers of larvae found later in the same plots. Substantiation of these observations has been sought by laboratory tests.

In these tests Black-leaf "40" at the strengths of 1-100 and 1-250 killed all the eggs which were not parasitized. It is interesting to observe that Black-leaf "40" does not destroy the egg parasites. Parasitized eggs included in the experiments yielded the adult wasps even when sprayed with the greatest strength of Black-leaf "40".

Recommendations. — The experiments here recorded indicate that almost complete relief from squash vine borer attack can be gained by four applications in July of Black-leaf "40" at a strength of 1 part in 100 parts of water, where the applications are made with a power sprayer. At the same strength, the material is over 90 per cent effective applied with a low-pressure, small-capacity outfit such as the compressed air sprayer. Applied at a strength of 1 part in 250 parts of water with the aid of a power sprayer, the material is also over 90 per cent effective. Lead arsenate gives too small a percentage of control to warrant its use.

On the basis of the experimental evidence, the following recommendations are made for the use of nicotine sulfate against the squash vine borer.

1. If a compressed air sprayer, knapsack pump, or other small capacity, low-pressure outfit is to be used, apply Black-leaf "40" at the rate of 1 part in 100 parts of water (1.3 fluid ounces per gallon) making 4 applications, one week apart in July.
2. If a machine capable of maintaining a pressure of 100 to 150 pounds per square inch is to be used, such as a good barrel pump or a power outfit, apply Black-leaf "40" at the rate of 1 part in 250 parts of water (3.2 pints in 100 gallons), making 4 applications, one week apart in July.
3. In spraying, be sure to drench all sides of the stem at the base. See that the leaf-stalks, and the under and upper surfaces of the leaves are thoroughly sprayed. When the plants have started to run, it is hardly necessary to spray the runners beyond three or four feet from the center of the hill.
4. Thorough spraying will largely free the sprayed fields from borers. Extermination may then be made complete by an examination of the plants in mid-August, cutting out those borers that have escaped the spray.

Spraying may be begun during the first week in July. It would be better, however, to examine a few plants closely every day during the last week in June, in order to discover the first eggs. The first spray should be applied not later than a week after eggs are discovered.

Cost of Treatments Versus expected Profits.

Nicotine sulfate is a relatively expensive insecticide, and any spraying operation using this material at a strength of one part in one hundred parts of water, or one part in two hundred fifty parts of water, is a costly treatment, which will be quite likely to prove impractical under certain conditions of squash culture (*i.e.*, where the squash vine borer is not a serious pest).

The expense of treatment can be materially reduced by following the suggestions given below.

1. To facilitate spraying squashes, plant in wide rows with the hills close together in the row. This type of planting allows free passage of the spray rig between the rows, and little time is lost in stepping from hill to hill.

2. Thin to the desired number of plants in each hill as early as is compatible with good farm practise. In this way, no spray material is wasted on plants that are later to be destroyed.

3. Equip the four-foot spray rod with a 45° angle disc nozzle with a small hole in the disc. This breaks the spray up into a very fine mist which covers quickly and thoroughly with a minimum of waste. In addition, equip the base of the spray rod with an automatic shutoff of the spring-grip type, so that the stream can be stopped instantly, thus allowing no wastage when passing between hills. This type of equipment can be used as well with a compressed air sprayer or one of the knapsack type as with a barrel pump or power outfit. With a power outfit, regulate the pressure at from 100 to 150 pounds per square inch.

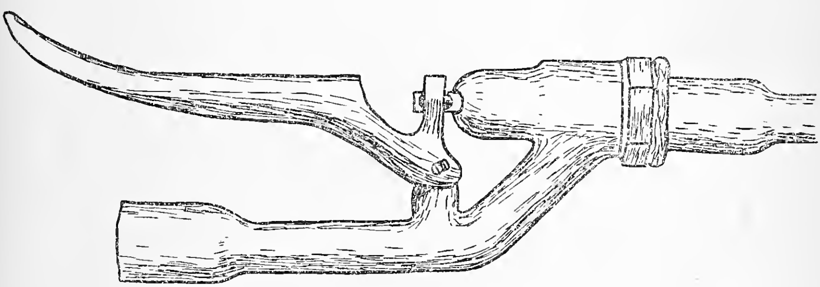

Fig. 2.—Automatic Shutoff Used in Experiments.

What may be called the average cost of spraying squashes has been figured from the records kept of the experimental work. The cost per acre can be seen to vary enormously, depending on the type of planting (hills per acre and plants per hill) and the stage of growth of the plants during the period of spraying. The figures given below are for four treatments, one week apart in July, applied to an acre containing one thousand squash plants of average growth.

1. Using compressed air or other small capacity, low-pressure outfit. Black-leaf "40", 1–100 recommended.

Dilute spray material, 150 gallons containing Black-leaf "40", 1.5 gallons at $12.50	$18 75
1 man, 24 hours at $.40	9 60
Total cost per acre of one thousand plants	$28 35

2. Using a barrel pump or power outfit giving a fairly large delivery at 100 to 150 pounds pressure. Black-leaf "40", 1–250 recommended.

Dilute spray material, 275 gallons containing Black-leaf "40", 1.38 gallons at $12.50	$17 25
3 men — 1 horse, 6 hours at $1.55	9 30
Total cost per acre of one thousand plants	$26 55

If the type of planting calls for more than 1,000 plants per acre, the cost of treatment is increased accordingly.

In an effort to discover the average increase in yield which might reasonably be expected from the use of the above treatment, and the relation of the value of this increase to the cost of treatment, letters were sent to prominent squash growers in various parts of the State. The replies received from those portions of the State where the borer is well established have been tabulated as follows:

Table VIII. — *Average Expected Increase in Yield of Winter Squashes.*

	Average Yield Per Acre (Tons).	Estimated Per Cent Increase from Borer-free Plants.
1	–	100
2	8.0	20
3	12.0	5
4	–	100
5	8.5	10
6	3.0	50
7	8.5	30
8	6.0	60
9	10.0	10
10	5.0	200
Average	7.6	59.5

The average increase thus estimated is 4.5 tons per acre. The average wholesale price of winter squashes during the sales-from-harvest period, September 1 to November 15, appears to be $.03 per pound or $60. per ton.[1] The value of the expected average increase of 4.5 tons per acre is therefore $270. Subtracting from this figure the cost of treatment leaves an estimated average net profit of from $241.65 to $243.45 per acre.

Summary.

The squash vine borer is a serious native enemy of winter squashes and related plants, for which no adequate remedy has previously been devised. The adult insect is on the wing during July, laying its tiny, reddish eggs upon the squash plants. The borers developing from these eggs cause the vines to droop and die by tunneling in the stem and girdling the plant, throwing masses of yellow frass out through holes in the stem, and causing the stem to rot. These larvae leave the vines in the fall, and spin cocoons in the soil. A number of cultural practises, such as fall plowing of infested fields, adequate fertilization to promote growth and to aid the secondary roots, and covering the runners with earth, have been recommended, as has the practise of cutting the borers from infested vines.

Experiments at this Station indicate that nicotine sulfate (Black-leaf "40"), at the strength of 1 part in 100 parts of water, kills over 97 per cent of the eggs, and, at the strength of 1 part in 250 parts of water, kills over 90 per cent of the eggs. Spraying should be done four times, at weekly intervals beginning the first week in July, using the stronger dosage with compressed air sprayers or similar machinery, and the weaker dosage with barrel pumps or power sprayers. When thoroughly done, spraying will largely eliminate borers from the fields. Complete extermination is then possible by cutting out the remaining borers during the middle of August.

The treatment is estimated to cost between $25. and $30. per thousand plants. Thus intensive methods of culture and careful, economical spraying must be the rule where the treatment is to be found practicable on a commercial scale. However, estimates of various squash growers regarding the expected increase in yield from borer-free plants indicate an average net profit of over $200. per acre from the use of this treatment. For the home gardener, to whom cost of production is a small item, it offers a ready means of successfully fighting this most troublesome enemy of squashes.

[1] Computed from the Boston Produce Market Reports, 1920–1923.

INDEX.

THE M. A. C. BULLETIN
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PUBLISHED EIGHT TIMES A YEAR BY THE MASSACHUSETTS AGRICULTURAL COLLEGE: JAN., FEB., MARCH, MAY, JUNE, SEPT., OCT., NOV. ENTERED AT THE POST OFFICE, AMHERST, MASS., AS SECOND CLASS MATTER

THE SIXTY-SECOND ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE

Issued in accordance with Section 8, Chapter 75, of the General Laws

PART I.—THE REPORT OF THE PRESIDENT AND OTHER OFFICERS OF ADMINISTRATION FOR THE FISCAL YEAR ENDED NOV. 30, 1924

Publication of this Document approved by the Commission on Administration and Finance

DEPARTMENT OF EDUCATION
THE COMMONWEALTH OF MASSACHUSETTS

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CONTENTS.

PAYSON SMITH, *Commissioner of Education.*
EDWARD M. LEWIS, *Acting President of Massachusetts Agricultural College.*

MASSACHUSETTS AGRICULTURAL COLLEGE.

PRESIDENT'S REPORT, 1924.

REVIEW OF THE YEAR.

Trustee Changes.

On June 17 last, the College received the sad news of the death of Mr. Elmer D. Howe at his home in Marlborough, Mass. Mr. Howe was born in Marlborough September 10, 1860, and was appointed Trustee by Governor William E. Russell in January, 1893, to succeed Thomas P. Root of Barre. He served continuously as Trustee until his death. He was a member of the Committee on Course of Study and Faculty since 1893, of the Committee on Farm and Horticulture (later Horticulture) since 1895, and of the Committee on Extension Service, of which he was Chairman, since 1914.

Mr. Howe was a graduate of the college in the class of 1881 and soon after graduation came to be recognized as one of the foremost agricultural leaders of the State. His life was wholly spent on the farm and the record shows that he was an excellent and successful farmer. Though always a very busy man he gladly found time to devote to the solution of many of the vital problems pertaining to the welfare of Massachusetts agriculture. He was potent in promoting the organization of the Grange in this State and subsequently was honored as its leader. Indeed, he was really interested in every movement aiming at the co-operative welfare of farmers and in his later years gave active support to the Farm Bureau movement. Mr. Howe was a kindly, patient, tender gentleman of the old school who commanded respect wherever he went. He loved the College and gave to it an affectionate and faithful service. His loss will be keenly felt by us all for a long time.

The Trustees have placed on record the following resolutions:

"*Whereas,* The Divine Master has seen fit to remove from this life Elmer D. Howe who for years has served faithfully and well as a Trustee of this College, giving of his time and energy that the best interests of agriculture in our Commonwealth should be advanced by agricultural education; therefore, be it

"*Resolved,* That the Board of Trustees of the Massachusetts Agricultural College mourn the loss of a sincere, courteous gentleman, with whom it was ever a pleasure to work, who always had the courage of his convictions, and who always had the best interests of the College at heart;

"*Resolved, further,* That a copy of these resolutions be sent to the family of the deceased and a copy placed upon our records."

On September 3, 1924, the Governor's Council approved the appointment of Mr. John Chandler of Sterling Junction as Trustee of the College to fill the vacancy caused by the death of Mr. Howe. Mr. Chandler is a graduate of Yale, and a successful farmer. For years he has been an active leader in various agricultural organizations; at present he is President of the Massachusetts Farm Bureau Federation.

Resignations, Retirements, and Deaths.

KENYON L. BUTTERFIELD.

The year 1924 will ever stand out, in the history of the Massachusetts Agricultural College, as the year which marked the close of the brilliant administration of Kenyon Leech Butterfield, the seventh president of the institution. As you

already know, President Butterfield resigned in May in order to accept the honored leadership of the Michigan Agricultural College — his Alma Mater, and brought his labors here to a close the following August. Elected to the presidency at the age of thirty-eight he gave to this institution, therefore, the very best years of his life, and during that long period he strove earnestly and at all times to promote its highest good with unswerving fidelity and singleness of purpose. His administration was characterized by great wisdom, untiring energy, fine idealism and rapid and continuous expansion both in service and in influence.

President Butterfield entered upon his duties at the Massachusetts Agricultural College with the clearly defined and openly avowed purpose of maintaining and developing a high grade agricultural college. The institution, as he conceived it, should teach and study the fundamental sciences underlying the agricultural industry, train skillful farmers, educate leaders in the various agricultural professions, disseminate information concerning agriculture and the farm home to the people of the State, and in every way promote every interest of the countryside and country life. Under him the work of agricultural research was heartily encouraged; the curriculum of the four-year course was expanded; graduate courses were organized; short courses were established; and a comprehensive system of extension service was developed.

His achievements and success were due to a broad understanding of the problem of agriculture in its every phase; a rare capacity in the organization of projects and plans; the ability to discover and enlist capable associates for the work to be accomplished, and to inspire their best efforts and co-operation in its successful attainment.

Besides remarkable gifts of leadership, President Butterfield possessed unusual powers of prevision. He was one of the first to advocate a scheme of popular dissemination of agricultural information. His pioneer spirit anticipated the nation-wide Extension Service. He was one of the first to see the problem of the farmer as inevitably concerned with distribution as well as with production. His foresight saw the rural problem as essentially a human problem and the social conditions of the rural people to be a prime and essential factor in maintaining a satisfying agriculture and rural life. In recent years he was defining the scope of the agricultural colleges as embracing the entire field of food supply, including production, distribution, consumption and preservation.

His abilities were early recognized, and gradually opened for him the door of a nation-wide service. In 1908 he was named as a representative of the State of Massachusetts to the White House conference in Washington to consider the problem of national conservation. In 1908, also, he was appointed by President Roosevelt as a member of the Country Life Commission. Associated with him were Gifford Pinchot, Liberty Hyde Bailey, and the late Henry Wallace, the late Walter Hines Page, C. S. Barnett, and W. A. Beard. In 1913 Woodrow Wilson appointed President Butterfield as a member of the American Commission on Rural Credits which spent four months in Europe making a careful study of agricultural credit and co-operation. In 1918 he was elected by the International Y. M. C. A. to take charge of the organization of vocational education among the American troops in France. In 1921 a commission was organized to visit China for the purpose of making a comprehensive study of her educational needs and of reporting a desirable educational program for that vast Empire. President Butterfield served on this Commission as the expert in vocational education.

We are too close to the administration and work of our recent leader to be able adequately to evaluate the character and magnitude of his contribution. Future historians will accord him, we may predict, a very high place in the list of the real leaders and pioneers of American agriculture and of American country life. All we can do at this time is to express simple and sincere gratitude, and to affirm with pride that Kenyon L. Butterfield was a man of broadest vision and of outstanding leadership — a wise administrator and builder — a gentleman of rare personal charm, of unbending moral convictions, and of highest ideals, who gave the unusual powers and energies of his best years joyously and unreservedly to the great cause of agriculture and to the education of the youth and people of Massachusetts.

Philip Bevier Hasbrouck.

On a beautiful summer morning last July our College community was shocked by the sad announcement of the sudden death of Professor P. B. Hasbrouck. He had been troubled during the past four or five years with a weakened heart. His spirit was such, however, that we lived in the hope that he would regain his strength and health once again. But it was not to be.

Professor Hasbrouck was born in Libertyville, Ulster County, New York, in 1870. He was graduated from Rutgers in 1893, having specialized in mathematics, physics, and civil engineering. He came to M. A. C. in 1895 as Assistant Professor of Mathematics. He was made Associate Professor of Mathematics and Adjunct Professor of Physics in 1903 and Professor of Physics and Head of Department in 1911. In 1905 he was appointed Registrar of the College.

In the death of Professor Philip Bevier Hasbrouck the College has lost a servant who possessed the qualities of a teacher in a marked degree. Scores of men who studied under him freely acknowledge and gratefully remember the devotion which was given so gladly and generously. In his capacities of teacher and registrar Professor Hasbrouck's opportunities for meeting students were many and frequent. In spite of his often brusque demeanor most of his students became his staunch friends and held him in highest esteem. So also did his colleagues, and all who saw beneath the exterior the sincerity of purpose and big heart of the man. Few men on any faculty are privileged to be so generally beloved. His death brought a heavy pang to many friends and closed a life wholly dedicated through many years to the service of the College and of "the boys."

John Phelan.

On August 31, 1924, John Phelan resigned to accept a position of larger responsibility under President Butterfield at the Michigan Agricultural College.

Professor Phelan came to the Massachusetts Agricultural College in 1915 as Professor and Head of the Department of Rural Sociology. He was an excellent teacher and attracted to his courses a comparatively large number of students. In 1918 he was appointed Director of Short Courses. In this position he rendered an outstanding service to the College. It was given to him to organize a two-year course in practical agriculture, in response to a legislative resolution that such should be established. In formulating this course Director Phelan introduced the feature of six months' practical farm experience, on approved farms under supervision; this training period comes between the first and second years of school work and must be satisfactorily completed before the student may graduate. Under his direction the winter school and the summer school were developed and enlarged in scope and new courses to meet special demands were established, notably short courses for florists, gardeners, and dairymen.

Immediately after the Armistice in 1918, the College announced its availability to train men discharged from the Army and Navy. Short courses were at once arranged and the registration was large from the first. Later M. A. C. was designated as the training center for New England to which disabled service men should be sent for rehabilitation in agriculture. Upon Director Phelan was placed the responsibility of organizing the many courses necessary to meet the varied requirements of such men. Over 650 Federal Board men have attended the College since 1919, and about 100 of them are still under the supervision of the Short Course organization. Through the Short Course as developed during the five years of Professor Phelan's leadership the usefulness of the College to the farmers of the State was significantly multiplied.

Henry S. Green.

After approximately three years of excellent service, Dr. Henry S. Green retired as Librarian November 12, 1924, having at that time reached the age limit.

New Appointments of Department Heads.

Basil B. Wood.

Upon the resignation of Dr. Green, Basil B. Wood was appointed Librarian of the College. Mr. Wood was for the past four years librarian at the Westerly, Rhode Island, Public Library. Previously he had served at the John Crerar Public Library in Chicago; at the Berkshire Athenæum in Pittsfield; at the Springfield City Library, and in the Army Camp Libraries at Camp Gordon and at Camp Lee. Mr. Wood is a graduate of Brown University in the class of 1905.

Roland H. Verbeck.

On September 19, 1924, Roland H. Verbeck was appointed Director of Short Courses to succeed Professor John Phelan. Mr. Verbeck was graduated from M. A. C. in 1908, having specialized in Agricultural Education. He served first as Principal of the High School at Petersham and subsequently as Principal at Parsonsfield, Maine. Prior to the war he pursued graduate study at Harvard University. In the summer of 1917 he enlisted in the air service of the United States Army and served a year in France. From 1919 till June, 1924, he served with marked success as Director of the School of Agriculture at Saint Lawrence University, Canton, New York.

Improvements and New Construction.

The buildings under construction and the improvements that have been made during 1924 are as follows:

1. The completion of the Chemistry Building at a cost of $300,000.
2. The addition to the Rural Engineering Building at a cost of $15,000.
3. The erection of the tobacco barn, $3,000.
4. The erection of the head-house at the Agronomy Greenhouse, $2,650.
5. Continuing the concrete walk, $1,000.
6. Numerous other improvements, such as the repairs to the East Experiment Station Greenhouse and the Agricultural Greenhouse.

Commencement, 1924.

At the commencement exercises held June 19, 1924, eighty-six B.S. degrees were awarded, eighty-two to men and four to women. The Degree of Bachelor of Vocational Agriculture was conferred upon one student who had entered from the Norfolk County School of Agriculture and had completed four years of undergraduate work on the basis of a modified program. The Degree of Master of Science was conferred upon four men, the Degree of Master of Landscape Architecture upon one, and the Degree of Doctor of Philosophy upon one.

The Commencement address was delivered by President Kenyon L. Butterfield upon the topic "Facing the Future." This was the final official appearance of President Butterfield before the College he so dearly loved.

Enrollment of Students.

The enrollment of students in the four-year course this autumn is 489, an increase of 56 over a year ago. This increase is due to the larger freshman class which this year numbers 183 as compared with 125 in 1923. This year's freshman class has substantially the same enrollment as had the class entering two years ago. The total enrolled in work of college grade including graduate and special students is 571, an increase of 60 over the enrollment of 1923.

Owing to the small class entering the two-year course in 1923, the total enrollment this year in that course is slightly less than that of a year ago although the number entering the first year class in 1924 increased by 14 over the enrollment of the preceding year. The total enrollment in 1924 is 164 as compared with 173 in 1923.

Work in Home Economics.

Since 1919 courses in home-making have been offered at M. A. C. The increasing interest in these courses, and the demand from the resident women students for additional work, together with urgent requests from many High School girls who have wished to pursue a major in Home Economics as part of their college work have steadily pointed towards the need for developing this work.

At the opening of the College year in September, 1924, more adequate provision was made for women students who wished to pursue a major in Home Economics. The emphasis is upon home-making as a fundamental vocation and will involve such courses as the study of clothing, its choice, cost, care and construction; the selection and preparation of food; nutrition and dietetics; the planning, furnishing and management of the home; the health of the family, including the care and health of children; and community relationships of the home. Thirty-one girls entered with the freshman class this autumn, and at present the total enrolled in the four-year course is 59. Some of these will undoubtedly wish to major in Home Economics and all of them will probably want to take more courses in the subject than was heretofore possible.

Boys' Camp.

In 1924 for the second time a summer camp for boys was conducted. Both of the camps have been run along lines which result in a nominal net expense to the institution. The camp was directed by Mr. Richard A. Mellen, Field Agent of the College, assisted by student counsellors. The average weekly enrollment for each of the four weeks in 1924 was 20. The daily program included elementary instruction in various agricultural subjects. One serious handicap under which the camp operates is that it has no adequate facilities for swimming, and other water sports.

Food Supply.

In recent years President Butterfield defined the scope of the agricultural colleges as that of embracing not only production and distribution of food but also its consumption and preservation. There was presented to the Legislature of 1924 a bill authorizing the appointment by the Governor, of a Commission which would study the questions of the Massachusetts Food Supply. Inasmuch as this bill had been introduced jointly by the College and the Department of Agriculture and had the support of various commercial organizations it was hoped that favorable consideration would be given it by the Legislature. The bill, however, was finally rejected. In the furtherance of this project numerous addresses were delivered during the year before Women's Clubs, Rotary Clubs, Chambers of Commerce, Granges, etc. Members of our staff who delivered addresses on the Massachusetts Food Supply and the number of them are as follows:

	No. of Lectures
President Kenyon L. Butterfield	10
Dean Edward M. Lewis	8
Director Sidney B. Haskell	8
Director John D. Willard	6
Professor A. E. Cance	7
Professor John Phelan	11
Dr. R. J. McFall	1

Gifts to the College.

During the year the College has been the recipient of several handsome gifts to be used for the promotion of scholarship and to assist needy students and farmers. They are:

1. The Frederick G. Crane Fund.

The family of the late Frederick G. Crane of Dalton presented to the College a gift of $25,000 to establish a fund in memory of Frederick G. Crane, the income therefrom to be expended by the Trustees in aid of worthy undergraduate four-year students of limited financial resources attending the College, preference being given to residents of Berkshire County.

The initial announcement concerning the distribution of this fund provides that all applications for loans or gifts from this fund shall be made to the President of the College, under whose direction an investigation will be made as to the relative merits of the applications. The purpose of this investigation will be to insure that the aid is extended to students whose parents are in such financial condition that assistance is necessary in order to insure a college education for the applicants; that it be extended only to students who propose to complete their college education at the Massachusetts Agricultural College; and that it be given only to those whose character and scholarship record justifies it.

Grants from the Crane Fund are made to freshmen in the form of loans supported by notes bearing endorsements satisfactory to the President of the College. These notes bear interest and are negotiable. The College, however, will at its discretion cancel these notes at the end of one year if the scholarship record of the student, his character, and his plans for the future appear to the President so to warrant.

Grants are made to sophomores either on the plan outlined for freshmen as given above or on the plan outlined for juniors and seniors as given below.

Grants to juniors and seniors are usually in the form of gifts and are awarded with consideration of the need, of the scholarship, and of the character of the applicant.

The amount of grants from this fund, made either as loans or as gifts, will be determined by the need of the applicant in each case and by the amount of money available in the fund.

2. Scholarships in Agriculture and Horticulture.

One thousand dollars have been provided by the Massachusetts Society for the Promotion of Agriculture to be awarded to four-year students enrolled from Massachusetts and majoring in the Divisions of Agriculture and Horticulture, for meeting their expenses at M. A. C. for the college year 1925–26. It has been decided that these prizes shall be awarded as follows:

Two scholarships of $200 each to members of the class of 1927 who are majoring in the Division of Agriculture or Horticulture.

Two scholarships of $300 each to members of the class of 1926 who are majoring in the Division of Agriculture or Horticulture.

In awarding these prizes, consideration will be given to

1. Excellence in scholarship in all subjects up to the time the awards are made.
2. Attitude toward work.
3. Personal character.

The scholarships will be awarded by a Committee consisting of the Head of the Division of Agriculture, the Head of the Division of Horticulture, and the President of the College.

These scholarships will be granted only as in the opinion of the Committee of award, the achievements of those eligible warrant the award.

3. The Porter L. Newton Fund.

The residue of the estate of the late Porter L. Newton of Waltham estimated to be approximately $25,000 has been left to the Massachusetts Agricultural College for the purpose of establishing "a fund to be known as the Porter L. Newton Fund, the income of which is to be used by the administrative officers of said College as scholarships for the education of such citizens of the United States, as said Trustees may deem worthy and deserving of the same."

4. The Lotta Crabtree Fund.

By the will of the late Lotta Crabtree the residue of her estate estimated at from $1,000,000 to $2,000,000 was left in trust for the benefit of graduates from the Massachusetts Agricultural College desiring to establish themselves in farming. This bequest will be administered by a separate board of Trustees appointed by

the Testator. Neither the exact amount of the bequest nor the conditions under which it shall be administered are as yet known.

These bequests disclose a growing interest in the Massachusetts Agricultural College by those who are making bequests for charitable and educational purposes.

5. Special Prize.

Last year the Trustees of the Frederick Cornelius Eldred Memorial Athletic Fund offered a prize of $50 to that member of the Senior class of the College who should make the most constructive suggestions for the physical development of the student body with particular reference to the portion which does not participate in the major sports. The same prize is generously offered again for 1924–1925.

Infirmary.

Director Marshall, who has charge of the Infirmary, reports that the present year has been very satisfactory from several standpoints. There has been less contagious illness than usual and the nurse and matron are doing their work most acceptably. Dr. Marshall repeats, however, with some emphasis, his statement of two years ago to the effect that our quarters are altogether inadequate not only to meet serious epidemic conditions but also to meet normal demands. The increasing number of women, necessitating separation facilities raises the question of enlarged quarters more seriously than ever. *I agree with him entirely that some action is very much needed.*

Market-Garden Field Station.

The Market-Garden Field Station was established in 1916 as a branch of the Department of Market Gardening at the Massachusetts Agricultural College. Acting in co-operation and with the advice of the Boston Market Gardeners' Association a tract of twelve acres of land was bought in North Lexington upon which suitable greenhouses and service buildings were erected. The work was organized under the direction of Professor H. F. Tompson, then Head of the Department of Market Gardening, and was carried forward on the land in North Lexington until the late summer of 1924.

During the year 1923 an offer came from the estate of the late Cornelia Warren of Waltham through her executor proposing that certain land could be given to the Commonwealth for the use of the Massachusetts Agricultural College, either for the work in vegetable gardening or for other purposes. After much consultation authority was secured from the General Court to accept this gift with a view to the removal of the Market-Garden Field Station to the new site in Waltham.

The land in North Lexington with the buildings was sold in September, 1924, possession being given October 1, 1924, and the portable effects of the Field Station with its records and personnel was moved to the new location in Waltham.

Under authority given by the Legislature the funds ($25,000) received from the sale of the North Lexington property have been used in providing new quarters on the land in Waltham. Certain of the old buildings which came with the property have been remodelled and adapted to their new uses and a new office building and greenhouse are being erected.

Goessmann Laboratory.

The Goessmann Chemistry Laboratory was sufficiently near completion so that classes were scheduled there at the beginning of the fall term. It will be recalled that the Legislatures of 1922 and of 1923 appropriated $300,000 for the construction and equipment of this building. The building was formally dedicated October 3, 1924. All the children of the late Dr. Goessmann were present. Representatives from educational institutions and a number of alumni of the College interested in Chemistry were guests of the College.

The following program was carried out:

Acting President EDWARD M. LEWIS, presiding.

The Building	Dr. Joseph B. Lindsey, '83 Goessmann Professor of Agricultural Chemistry and Head of the Department.
Charles A. Goessmann (Chemist and Philosopher)	Dr. Frederick Tuckerman '78 of Amherst.
Chemistry and Human Nutrition	Dr. Thorne N. Carpenter '02 Nutrition Laboratory, Boston; Carnegie Institution of Washington.
Chemistry and Agriculture	Dr. Charles A. Browne, Chief, Bureau of Chemistry, United States Department of Agriculture.

Mount Toby.

There has recently been organized an Advisory Committee to co-operate with our Forestry Department in the development and management of the Mount Toby Demonstration Forest. The Committee selected consists of Mr. Andrew C. Warner, Sunderland, Mr. Walter D. Cowls, North Amherst, and Mr. Charles H. Beaman, Leverett.

Recommendations for Legislation.

Two amendments to existing laws affecting the college were laid before the Legislature of 1924. One proposed to reduce the tax levied for the inspection of feeds from $20 to $15. The reason given for the change was that the present tax is higher than is justified by the work done. The appropriation for this work in 1923 was $9,000 and the income was $19,420.

The second amendment sought to take from the Department of Administration and Finance the editorial supervision of research bulletins of the Massachusetts Agricultural Experiment Station.

Both of these bills were referred to the next General Court.

MASSACHUSETTS AGRICULTURAL COLLEGE LEGISLATIVE BUDGET, 1925.

Projects for Permanent Improvement.

1. HORTICULTURAL MANUFACTURES BUILDING, $60,000.

The importance of utilizing various by-products of the farm which formerly were wasted, such as fruit and vegetables, was emphasized during the war, and under the direction of Prof. W. W. Chenoweth of this institution farmers came to see whereby this saving could to advantage be made permanent. In order to give adequate instruction in the preservation of fruit and vegetable products, a new laboratory building is essential. The plans provide for a one-story building of inexpensive construction, which will furnish laboratories for the various phases of this work.

The pressing need for this building is now generally understood. However, some of the principal considerations may be recapitulated as follows:

(*a*) The department of horticultural manufactures now has its work widely distributed in four buildings, viz., Flint Laboratory, Wilder Hall, French Hall, and a workshop on the hill near the cold storage plant. This wide scattering of the work is obviously very detrimental to its objective.

(*b*) The principal teaching is done at Flint Laboratory in rooms which were designed for use by the dairy department. The dairy department needs these rooms and would like to see the department of horticultural manufactures cared for elsewhere as soon as possible.

(*c*) The present quarters are entirely inadequate for the teaching work. On account of the limited space the department has been compelled to refuse admission to numbers of students. This is perhaps the only department in the institution which has been compelled frequently to refuse admission to students on account of lack of space. All the teaching could be much better organized and more efficiently conducted in a new building designed for this particular work.

(*d*) It is highly desirable that vigorous research work be undertaken at the earliest opportunity in the field of fruit and vegetable preservation and the manufacture of by-products. A strong demand exists for this work among fruit growers, but the subject is equally important to all consumers of food in Massachusetts.

(*e*) The department is now carrying on important extension work, but these extension projects need to be strongly supported by effective work at the college, and especially by well-directed research work.

(*f*) The Massachusetts Fruit Growers' Exchange Association, the Boston Market Gardeners' Association and other organizations have urgently requested this proposed building. This demand from the fruit growers and vegetable growers should be squarely met.

2. Tunnel from Power Plant to Stockbridge Hall, $38,500.

The principal argument advanced in support of this project is the recommendation made by French and Hubbard, engineers, who recently made a study of the present heating plan and future development for the same, "that a tunnel be constructed to Flint Laboratory and Stockbridge Hall and the piping arranged so that exhaust steam can be used in these buildings. We are firm believers in tunnels for steam mains of this kind, and believe that when it is necessary to rearrange the underground piping, tunnels should be constructed. We would recommend this both for economy in the long run and on account of convenience in repairs and pipe insulation."

At present none of the underground steam lines are enclosed in tunnels. The result is a high cost of maintenance because of the excessive radiation and because of the difficulty in locating and repairing leaks. Also, at present, the maximum use is not made of exhaust steam; this latter difficulty would be met by the project here outlined.

3. Women's Gymnasium and Equipment, $16,450.

With the increased number of women students attending the College, the need of a women's gymnasium becomes imperative. With the appropriation here requested it is proposed to erect a wooden frame building adjacent to the present Women's Dormitory. Placed in this location it will be unnecessary to duplicate dressing rooms and shower baths. The amount requested will provide for the necessary equipment for the building.

4. Roads and Walks, $10,000.

In order to secure a system of improved roads and permanent walks on the campus, it is proposed to build small sections of each from year to year. In 1925 it is planned to extend the macadam road, provided in 1923, from the Chapel to the Power Plant, and to lay a granolithic walk from South College to the Drill Hall.

5. Living Quarters for Foreman at Tillson Farm, $6,000.

Recently the barn cellar on the Tillson Farm was converted into an incubator cellar by repairing the walls and constructing a suitable roof. These repairs, however, have been partial and it is now proposed to raise the roof in order to provide a two-story building. The upper floor will furnish living quarters for the foreman and the main floor will be used as an experimental laboratory, egg room, operating room, office and shop. These improvements have already been delayed beyond the point of economy in operation.

6. Extension of Present Enclosed Athletic Field Area, $22,500.

It is proposed to extend in a southerly direction the present athletic field and to include in the enlarged area twelve tennis courts and two skating rinks, as well as to relocate the running track. The estimate covers the cost of extending the fences and grading and draining this area.

7. Other Permanent Improvements for Athletic Field Area, $10,500.

This project is connected with that preceding and is intended to provide the permanent improvements for the enlarged field. The principal items are:
1. Piping water to the field for sprinkling, flooding, and drinking purposes.
2. Installing wire fencing for tennis courts.
3. Building walls for skating rinks.
4. Moving the quarter mile track.

8. Tunnel to First Pit South of Power Plant, $4,615.

This project has been under consideration for several years but has not been pressed more urgently because of other demands. Its purpose is to provide for an underground system of steam piping for a distance of sixty feet from the wall of the power plant, extending to a point where the steam mains for the south side of the campus branch.

9. New Steam Line from East Experiment Station to Microbiology Building, $4,705.

This project contemplates replacing a section of underground pipe line which is now in poor condition. The new line would be 385 feet shorter than the present one, thus effecting greater economy in operation.

10. Livestock Replacement, $4,000.

In order to maintain satisfactorily the present pure bred strains of livestock including horses, cattle, sheep and swine, it is necessary to buy certain animals each year. The funds received from the sale of stock would be sufficient to maintain the inventory on a satisfactory basis. Under present conditions, however, it is necessary from time to time to seek special appropriations for this purpose. In 1925 the amount requested is $4,000.

11. Fencing Fruit Plantations, $3,000.

The fruit plantations of the Horticultural Department are every year subject to serious raiding, besides the constant loss of fruit from visitors who stroll through the orchards and vineyards and help themselves to small quantities of fruit. An attempt has been made to prevent the raiding by patrolling the orchard. Loss due to the second cause cannot be stopped in this manner. It is believed that both types of loss can be largely prevented by fencing the main fruit plantations. The present estimate contemplates enclosing only such plantations as are now bearing fruit. Nine thousand linear feet of fence would be provided by the amount asked under this item.

12. Culvert for Brook in Ravine, $2,505.

In order to provide adequate storage place for the large supply of coal which now has to be carried during part of the year, it is necessary to construct a culvert over a section of the stream which runs through the ravine adjacent to the Turbine House. The proposed culvert would be 175 feet long, four feet high and five feet wide, and can be constructed at an estimated cost of $14.32 per linear foot.

13. Refrigerating Plant at Paige Laboratory, $2,000.

For years it has been impossible satisfactorily to maintain the animal and poultry disease specimens and to conserve the various kinds of diagnostic sera made in the Department of Veterinary Science and Animal Pathology. Two small re-

frigerators which require daily icing are now used but are inadequate for the present demands. The addition proposed is necessary in order to save valuable perishable materials.

14. Additional Land at the Cranberry Station, East Wareham, $1,000.

The total area of land, the purchase of which is contemplated by this item, is sixteen acres in the larger parcel; one acre, forty rods, in the smaller. The latter area is needed for the purpose of straightening the present boundary and preventing possible undesirable neighbors. The former area is required for three purposes, namely:

As source of sand for sanding the bogs.

Turf for building dams, dikes, and embankments.

An area of some eight acres, a part for enlargement of the blueberry plantation's work, another part for testing new varieties of cranberries, and engaging ultimately in formal breeding work.

REPORT OF THE DEAN.

Much of the work of the Dean's office during the year just ended had to do with administrative matters of scholarship, schedule and student welfare.

From the very start every effort was made to have the new men begin right. To bring this about a new departure was taken this year through the introduction of a "Freshman Week." The schedule for this week was carefully planned with a view to introducing the entering student to his new environment in the shortest possible time with the least possible upset. Freshmen were asked to report three days ahead of the date set for the opening of college. This time was used for lectures on College Life, important college regulations, fraternities, scholarship, methods of study, campus employment and schedules. Mental tests, under the direction of the Department of Education, were also given during this period. These preliminaries were over when the members of the three other classes arrived on the campus for the formal opening of college, which came on Thursday afternoon. The time from the opening of college to the end of the week was given over entirely to class registration, lesson assignments and fraternity rushing. No rushing was permitted after this period. Accordingly, regular class work began the second week without any interference or loss of time.

All Freshmen were assigned to Advisers who acted as counselors and guides, nd through whom almost personal attention was given to every new student. This advisory scheme, now in operation for a number of years, has given general satisfaction.

The advisory group this year was made up of the following members of the faculty chosen especially because of their sympathetic interest in students and their problems:

Halliday, Raymond.	Phillips, A. W.
Julian, A. N.	Porter, W. R.
Lanphear, M. O.	Rand, F. P.
Machmer, Wm. L.	Rice, V. A.
Mackimmie, A. A.	Yount, H. W.
Moore, F. C.	Skinner, Miss.

A preliminary scholarship report on all Freshmen was received in the Dean's Office at the end of the third week. This report helped to size up the men and enabled the advisers to work more effectively with their advisees. About three weeks later another more complete scholarship report was received. This report was mailed to the parent directly through the adviser. In this way co-operation between parent and adviser was established. This essential relation proved very helpful.

The Sophomores, Juniors and Seniors were almost entirely handled by the writer personally as far as scholarship was concerned. A complete report of their scholastic work was received from the instructors about six weeks after the open-

ing of each term. If this report was not satisfactory the student was called into personal conference. Good results followed from such conferences.

While the scholarship problem is still with us and undoubtedly ever will be, yet we feel that it is receiving careful and sympathetic attention and that as a result, our efforts in behalf of deserving students will become increasingly effective.

The regulation introduced last year withdrawing the cut privilege from Freshmen was, at the request of the Student Senate, extended to include the members of the Sophomore class. The two lower classes are now working under this system, which seems to meet with very general approval from both faculty and students.

Recognizing that college teaching can and ought to be better, a distinct beginning was made last winter to bring this about. A series of five teachers' meetings were held at intervals of two weeks to consider methods of teaching and ways and means for improving teaching practices at the Massachusetts Agricultural College. The meetings were in charge of members of the staff and were very suggestive and helpful.

The death of Professor Philip B. Hasbrouck, Registrar of the College since 1905, on July 19, 1924, threw a new duty on the writer, who was appointed Acting Registrar. This meant the handling of the Dean's and Registrar's work under one head. The undertaking was rather an ambitious one and has necessarily forced the adoption of a "carry on" policy. Outstanding new ventures could not be undertaken. The clerical force in both the Dean's and Registrar's Offices deserves great credit for its loyalty and willingness to carry added responsibilities.

The student morale was good. The finest spirit of whole-hearted co-operation was noticeable on every hand. Buoyed up by this undivided support we were able to carry rather easily the very numerous burdensome duties of an unusually exacting year.

Wm. L. Machmer,
Assistant Dean.

REPORT OF THE DIRECTOR OF THE EXTENSION SERVICE.

The year 1924 has seen the further development and carrying out of extension policies and plans which have been the basis of work in the past. Projects have been developing with each year's experience so that they are close to the needs of the farms and rural homes of the state. The underlying needs of agriculture and home-making must always be the starting point in our work. These have not changed materially during the year.

The agriculture of Massachusetts is, however, passing through an adjustment period. High prices during and immediately following the war enabled many inefficient farmers to make profits. Those days are over. Dairymen, poultrymen and market gardeners are finding it necessary to reduce the costs of production if there is to be a profit at the present market prices. Our service to them must be to enable them to reduce costs of production so that they can still compete with farmers in other areas who are selling in our markets. The successful low-cost producer still has good opportunity, but the day for the inefficient high-cost producer has gone. Readjustment is a bitter process to those who cannot make the changes, but it is inevitable. Fortunately, the majority seem to be finding ways of meeting changed conditions, and complaints come largely from those who do not yet sense the nature of the change. It is a matter of hopeful significance that Massachusetts producers see the futility of trying to raise prices by artificial means and are looking to careful management of their own farms for salvation.

The war brought greater spending power to the majority of city dwellers who at once converted this into ampler standards of living. Rural homes are not so easily provided with even the ordinary comforts which city populations enjoy. Educational assistance to country home-owners to make their homes as attractive and enjoyable as those in the city is much in demand. The call for educational service in clothing and textiles has grown beyond our capacity to meet it. With the filling of the vacancy in our staff, work in nutrition can again be resumed, and the time of the specialist is already booked for months to come.

Boys and girls remain in club work longer than formerly. This is evidence of a feeling that values received are greater. The out-of-the-way corners of the rural sections are being studied more carefully, and the opportunity for club activities is reaching those boys and girls who most need it.

The most important staff-change of the year has been the filling of the position of Extension Specialist in Nutrition, vacant since the summer of 1923. Miss Mildred L. Wood has taken up this work, coming from county and city extension work in Iowa and Minnesota, and from study in Teachers College, Columbia. It is a common observation that extension work in nutrition is less spectacular than in other branches, and appeals primarily to thoughtful home-makers who are conscious of the importance of diet in the family welfare. It is a project which cannot be reported in as vivid a manner as some others because it is not as susceptible to exhibit as others.

Professor H. F. Tompson resigned from the position of Extension Specialist in Vegetable Gardening in order to go into business, and was succeeded by Professor R. M. Koon, who came to us from Delaware. Professor Joseph F. Whitney resigned from the position of Extension Specialist in Landscape Gardening to undertake professional work with the Mariemont Company in Cincinnati, Ohio, and the position is still vacant. Miss Dorothy Murdock resigned from the position of Assistant State Leader of Junior Extension work in order to undertake the practice of home-making, and was succeeded by Miss Harriet M. Woodward, who came to us from home demonstration work in New Hampshire. Professor Frederick E. Cole resigned from the position of Extension Specialist in Pomology to become Manager of the Nashoba Fruit Growers, and was succeeded by Professor Wilbur H. Thies, who came to us from Michigan Agricultural College.

Much attention has been given to teaching methods, in order to reach the larger groups. We have found much demand from the more vigorous and progressive farmers and home-makers, but too often those who most needed to change their practices to survive under present competitive conditions were the slowest to sense the need. The year has marked progress in this effort. A more complete statement of this will be included in Part VI of the annual report of the Massachusetts Agricultural College.

In July the Extension Service issued a cautionary letter relative to the proposed New England Dairy System. It was felt that many farmers would be tempted to join it expecting monopoly profits and high prices. The era of high prices for milk in Massachusetts has passed. The prices of the future will be based on the reactions of supply and demand, as the actual net prices have been for the past few months. The warning from the College received very widespread publicity and much adverse criticism. It is perhaps sufficient to report that the bitterest critic of the College for its position is now advocating the very basic concept on which the warning was founded. It is our conviction that the warning, which was issued simultaneously and in the same form by the Director of Extension in Vermont, saved hundreds of thousands of dollars to the farmers of New England, and prevented the undertaking of a co-operative venture which was unsound in its initial plans. It should be noted, however, that the plans for the New England Dairy System have been revised, and in its ultimate form the organization has a chance to prove of substantial benefit to its members.

Relationships with co-operating agencies have been excellent, and during the year have been developed to better efficiency. This is true alike of the State Departments of Agriculture and Conservation, and with one exception of the County Extension Services.

The county extension organizations have maintained excellent effectiveness and morale. We believe more firmly than ever that a co-operative program of extension work which utilizes the college as a resource agency and the county staffs as the agencies for direct application is most effective. Supporting this is the United States Department of Agriculture, the largest resource organization as well as the largest research organization in the world.

Co-operation with commodity organizations is stronger than ever, with mutual benefit. Educational programs can be carried forward very effectively through the membership activities of such organizations. It is the plan and practice of the

Extension Service to look to such organizations for counsel on the basic needs of the industries which they represent.

We are under very great pressure for materials and leadership in the home-management project. The need of a full-time specialist in this field is urgent. It is to be hoped that the various budgetary and appropriating agencies can find a way to create this new position, which is the only one requested in our budget for the year 1925.

In summary, the year shows marked gain in teaching efficiency, in numbers reached, in understanding of underlying problems, and in the development of materials to meet needs. A detailed report on projects will be found in Part VI of the Report of the Massachusetts Agricultural College.

John D. Willard,
Director of the Extension Service.

REPORT OF THE DIRECTOR OF THE EXPERIMENT STATION.

One of the economic lessons gained from the period of agricultural depression through which we are happily passing is that farmers in any given section are in competition with all other farmers who attempt to reach the same market. Massachusetts dairymen are in serious competition with the dairymen of Northern New England. Similarly the potato growers of Massachusetts must compete with those of Aroostook County, Maine; and unless they can place potatoes on the market at as low a cost as can their competitors naturally they will lose their market. With few exceptions, of which the Cape Cod cranberry is the most significant, the price at which our Massachusetts farmers must sell their products is determined by the total crop as produced in competing sections.

Self-evidently, it is impossible to confine to the borders of a single state the benefits of any agricultural research. Seldom can agricultural improvements be patented, or the methods of effecting such improvement be copyrighted. Such action, even if possible, would be undesirable, and not in the interests of public welfare. The results of all experiment station work regardless of where carried on are available to all farmers. Even though we must recognize this, it is nevertheless incumbent on the Massachusetts Station to direct its best efforts to bettering the competitive position of Massachusetts farmers. This it is attempting to do.

The branches of Station work in which distinct service is being rendered to Massachusetts agriculture as distinguished from competing agriculture, are shown in the following paragraphs:

1. *All Research Studies on Plant Diseases and Insect Enemies of Vegetation.*— Because of the fact that development of these obstacles to successful production is so profoundly affected by environment, this research work must be local. Work carried on during the year includes studies of the squash vine borer, the squash bug, the second generation of the codling moth, the hatching dates of a number of scale insects, study of insects affecting the cranberry, and control studies on the onion thrips. In plant diseases, study of carrot blight, of tobacco root rot, of cucumber mildew under glass, of scab and black rot of apples, of onion smut, and of tobacco wildfire are included in the year's operations, together with some co-operative study of certain cranberry diseases carried on jointly with the United States Department of Agriculture.

2. *Most Soil Management and Plant Nutrition Studies.* — These are mainly local in their application, even though the research may develop fundamental principles of wide application. The work of the year includes projects in soil management and fertilization of orchards, study of plant food relations in permanent pasture, and a new series of soil management studies for onions and tobacco. The net result of this work, when and as it is brought to successful completion, will be to better to a significant degree the competitive conditions under which our farmers work.

3. *Certain Studies in Animal Nutrition.* — The most significant at the present moment is investigation of substitutes for milk in the rearing of dairy calves. The situation in the Massachusetts dairy industry is one which puts a high value on

fluid milk, and which necessitates high producing cows in the dairy herd. The latter fact is favorable, the former highly unfavorable, to the breeding of high quality dairy cows. Apparently our Massachusetts farmers will not be able to replace their herds unless substitutes for milk be found. This project, however, when successfully completed, may develop fundamental principles of almost universal application.

4. *Local Studies on Markets and Marketing.* — The most important work of the year was study of costs of marketing Massachusetts apples. The object here was to give to the Massachusetts orchard industry the facts on which more economical operation may be based.

5. *Poultry Disease Studies, with Particular Reference to those Typical of Intensive Poultry Industry.* — The disease problem in congested regions differs significantly from that in other regions. This makes it necessary that the Station give good service in order that the industry may be maintained on a sound basis.

There are many other projects which have a much wider application. The work of the Department of Poultry Husbandry in breeding high egg laying strains of Rhode Island Reds illustrates the point. The increased economy which this high producing stock makes possible will be nearly as great an advantage to the competitors of Massachusetts poultrymen as to Massachusetts poultrymen themselves. Ultimately, of course, it can have but one result — to make possible the production of eggs at a lower cost than at present. Similarly, much of the study in agricultural economics, research on the properties of feeding stuffs, and fundamental studies in plant development are of ultimate fundamental significance to the people as a whole, rather than to any restricted group.

Demand versus Need for Research Work.

The above brings out a most important point. Normally the ability of the Experiment Station to undertake research work in any line depends on apparent demand for the same. Practically the need for this research antedates the demand, even by a score of years. The most successful research is that which avoids trouble, rather than merely remedies it after it occurs. If the work established two years ago on certain problems incident to tobacco culture had been started twenty years ago; and if the work on white diarrhoea control of poultry could have been instituted before the disease became prevalent, the farming industry of Massachusetts would have been saved from great losses. This represents one of the difficult problems of Station administration — to secure funds in support of fundamental research for which there may be no apparent demand, but which may be the most productive research possible, on account of its anticipating future needs. The fact that Massachusetts has in general been astonishingly liberal in its appropriations to its Experiment Station is a cause both for gratification, and increased sense of responsibility to the tax payers of the State.

Conditions affecting Station Work.

In the attempt to make the work of the Station apply most fully to the needs of Massachusetts, the fullest co-operation has been received from members of the Station staff. There is, however, a growing lack of contact between the Station men and those who should form the main clientele of the Station, — that is, the farmers of the State. This loss of contact is caused primarily by change in the character of the Station work, and secondarily by the fact that the Extension Service now serves as the liaison organization between the College and Massachusetts farmers. Further study needs to be given to the problem, for the fullest responsibility to the people of the State will not be obtained unless our workers are in contact with those requiring our research service.

Most of the conditions experienced during the year have been favorable. Great progress has been made in improving and equipping the various farm areas now available for Station work — the new Brooks Experimental Farm, the Harlow Farm for orchard experimental work, and the Tillson Farm for poultry breeding. The transfer of the Market Garden Field Station from North Lexington to Waltham gives to this branch of the institution greatly increased opportunities for effective

research. The increase of personnel at the Cranberry Station has likewise increased opportunities in its work.

Of unfavorable developments during the year there are two which are worthy of notice. The first is the very large turnover in the lower paid positions on the Station staff. The total of full time workers now in the service of the Station is forty-five. There were ten resignations during the course of the year, most of these being caused by dissatisfaction with the low salary schedule, coupled with the ability to find better opportunities elsewhere. This condition was reported to the Trustees in 1922. The second unfavorable condition is in the publication of results of research. Not for years has the Station had such a poor record. The conditions bringing about this unfavorable development are those described in my last annual report.

Sidney B. Haskell,
Director of the Experiment Station.

REPORT OF THE DIRECTOR OF THE GRADUATE SCHOOL.

Agriculture is, by common consent, the noblest of the professions. To exalt it and to hold it in its proper place in the eyes of the world should be the goal of every individual genuinely interested. Those engaged in agriculture and especially the leaders, should have real pride in their calling. Moreover they should be broadly trained. They must meet other professional classes on the same footing; they must develop a culture equal to any profession, a standard of life accepted by all conditions of society, and a mentality that will reflect credit and be conspicuous in all callings in which they may participate. Such is the objective of graduate work in agriculture.

The school flourishes and is accomplishing much as measured comparatively with other graduate schools, but we seek to accomplish much more in an effort to realize the full significance of the goal set above. It is pertinent to know what is being done by our graduate students. This can in a very meagre way be illustrated by the theses submitted by the candidates for higher degrees last June.

Mr. Stanley B. Freeborn received the degree of Doctor of Philosophy. He presented a thesis on "The Mosquitoes of California." This study extended over several years. Mr. Freeborn is connected with the University of California. His study has universal application.

Mr. John G. Archibald received the degree of Master of Science and presented a thesis considering "The Digestibility of Treated Grain Hulls for Domestic Animals." This was an extensive study within the Experiment Station and aims to make available a wider range of animal foods.

Mr. Roland W. Rogers, receiving the degree of Master of Landscape Architecture, offered a thesis in which he has elaborated grounds and buildings for an agricultural school in Albania. This has been done in conjunction with and at the request of those responsible for the enterprise.

Mr. Raymond A. Mooney, receiving the degree of Master of Science, has made a study of those "Physical Properties of Fertilizer Materials" which are constantly annoying to individuals handling fertilizers.

Mr. Stanley W. Bromley received the degree of Master of Science and offered as a thesis a study of "The External Anatomy of the Horse Fly." Such a study furnishes a basis for applications in eradication.

Mr. Warren B. Mack, who is connected with Pennsylvania State College, was the recipient of the Master of Science degree. He contributed as a thesis a study of "The Growth and Bearing Habit of Apple Spurs." The purpose of this study was to gain some knowledge of the peculiar habits of apple bearing that are familiar to those raising apples.

Such work means much to agriculture. While it represents intensely specialized investigation, yet it is the only method of moving ahead in any particular field.

Of course it is impossible to present in this connection the studies of graduate students apart from the above aspect of their activities, for graduate work is largely individual and its procedures independent.

Charles E. Marshall,
Director of the Graduate School.

REPORT OF THE DIRECTOR OF SHORT COURSES.

The work of the short courses is being carried on along the lines developed by former Director Phelan, with few apparent adjustments required at present. This report must deal largely with results secured during his tenure of office, for the present director did not assume charge until late in September. It is a pleasure to record here the fine type of organization as to curriculum, student morale, administrative machinery, and instructors, which has been built up by my predecessor during the past seven years.

Two-Year Course.

One cannot help feeling that a distinct educational opportunity has been provided with the development of the two-year short course. I believe it supplies a needed educational opportunity which, if broadly realized, will enable the College to constantly recruit the ranks of our agricultural population most directly. I say this because I do not view the decreasing enrollment figures in this course with alarm. In fact, with the Veterans' Bureau trainees no longer a contributing factor because of the practical completion of the government's rehabilitation program, we find the entering class this fall registers a slight increase. I am inclined to believe this year marks the ebb of the tide and while no great inflow should result, classes of a more normal size can be expected.

It is a source of much satisfaction to observe the capable work being performed by so many of the graduates in their various fields of occupation. Figures recently secured indicate that a large majority of the men and women, approximately eighty-six per cent, are actually engaged to-day in productive agricultural pursuits.

We have no slight problem to secure the right kind of summer training jobs for the students' practical work of six months in the freshman year. Ninety positions must be found for this year's class alone. Many of the best farmers in the state are assisting us in this program, not only by taking students to meet their labor requirements of the summer, but in a number of cases they find such men highly desirable for permanent positions after graduation. We plan to lay even greater stress on the practical training of the two-year students during this summer period, with the idea that students demonstrating a high standard of farm ability may offset minor class-room discrepancies. On the other hand a few students easily maintain good class grades, only to show little zeal, initiative, or skill in their farm training. No parent should expect the College to pass such men with its approval as vocationally trained in agriculture. They belong elsewhere in industry.

Mental tests given to the freshman group this year by the college department of education indicate a large percentage of the students have had much more than the minimum preparation required for the course. Arrangements were made for all male students to take the regular college physical examination, hitherto required only of members of athletic squads. This was conducted by Professor Curry S. Hicks, and the data secured has been helpful already in informing students of physical limitations, either chronic or corrective.

Tabulation of Students by Majors studied.

Animal Husbandry, 47; Dairy Manufactures, 9; Floriculture, 19; Horticulture, 18; Pomology, 29; Poultry, 29; Vegetable Gardening, 9; General Women's Course, 5.

Two-Year Course Enrollment for the Past Five Years.

1919, 209; 1920, 295; 1921, 302; 1922, 274; 1923, 169.

Winter School.

A new short-course plan was put in operation by the Department of Floriculture to provide a more balanced training in flower-growing. It was planned to alternate this Florist School with a Nursery School, scheduled for the coming

year. Not enough students registered to make this possible. A special course in Fruit Growing will be given in the winter of 1925 which should prove of interest to the fruit men of the state. The two week units in Dairy Manufactures, including ice-cream making and milk testing continue to prove popular, providing a short intensive course of lessons. New unit courses in milk plant operation and milk inspection replace butter-making and market milk as offered last year.

Summer School.

Collegiate credit for work taken in the summer school was given for the first time this year. This will undoubtedly interest many teachers of the state who wish to continue their professional training along lines of study we are excellently equipped to carry on. To many teachers of agriculture the new credit system will serve to meet state requirements for advanced study.

Placement Training and Supervision.

For the Veterans' Bureau field work three men are still employed under government salary. This force is being reduced gradually as the federal training program for ex-service men approaches completion.

The many problems in placing two-year students for summer training are being handled by Mr. Paul W. Viets with tact and understanding. He is making many valuable contacts with agricultural organizations to secure the best possible places and achieve the maximum results for both student and farm operator.

Roland H. Verbeck,
Director of Short Courses.

Table I. — New Appointments.

A. In the Academic Departments.

Instructor in Physical Education: Lorin E. Ball, B.Sc., Massachusetts Agricultural College, 1921.

Instructor in Physical Education: Edward L. Bike, B.Sc., Massachusetts Agricultural College, 1924.

Assistant Professor of Landscape Gardening: Prentiss French, A.B., Williams, 1917; M.L.A., Harvard, 1921.

Instructor in French: Raymond Halliday, A.B., Brown, 1920.

Instructor in English: Belding F. Jackson, B.Sc., Massachusetts Agricultural College, 1922.

Instructor in Agronomy: Willard P. Jones, B.Sc., University of Wisconsin, 1923.

Assistant Professor of Home Economics: Helen Knowlton, A.B., Mt. Holyoke, 1903; A.M., Columbia, 1924.

Acting President: Edward M. Lewis, A.B., Williams, 1896; A.M., Williams, 1899.

Instructor in Microbiology: John B. Nelson, B.Sc., Massachusetts Agricultural College, 1917; A.M., Harvard, 1923; Ph.D., University of Missouri, 1924.

Assistant Professor of Poultry Husbandry: John W. Patton,[1] B.Sc., Cornell, 1911; D.V.M., Texas Agricultural and Mechanical College, 1921; M.Sc., Kansas State College, 1924.

Instructor in Chemistry: Arthur W. Phillips, B.Sc., Tufts, 1915; A.M., Harvard, 1921.

Instructor in Zoölogy: Gordon C. Ring, B.Sc., Wesleyan, 1923; A.M., Wesleyan, 1924.

Instructor in Farm Law: Harold W. Smart,[1] LL.B., Boston University, 1918.

Director of Short Courses: Roland H. Verbeck, B.Sc., Massachusetts Agricultural College, 1908.

Assistant Professor of Microbiology: Chester H. Werkman, B.S.A., Purdue, 1919; Ph.D., Iowa State College, 1923.

Librarian: Basil B. Wood, A.B., Brown, 1905.

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[1] Temporary for one year.

B. In the Experiment Station.

Investigator in Botany: Theodore T. Ayers, B.Sc., Pennsylvania State College, 1924.
Investigator in Chemistry: Gerald M. Gilligan, B.Sc., Massachusetts Agricultural College, 1921.
Curator, Department of Botany: Gladys I. Miner.

C. In the Control Service.

Specialist in Poultry Disease Elimination: Patrick E. Bransfield, B.A., Wesleyan, 1912.
Analyst: George B. Dalrymple.
Technical Assistant: James J. McDermott.
Analyst: Alice H. Norcross.

D. In the Extension Service.

Extension Professor of Farm Management: Fayette H. Branch, B.Sc., Cornell 1914.
Extension Editor: John A. Crawford, B.Sc., Massachusetts Agricultural College, 1920.
Extension Professor of Vegetable Gardening: Ray M. Koon, B.Sc., Pennsylvania State College, 1914; M.Sc., University of Delaware, 1923.
Assistant Extension Professor of Pomology: Wilbur H. Thies, B.Sc., Michigan Agricultural College, 1919.
Assistant Extension Professor of Nutrition: Mildred L. Wood, A.B., Rockford College, 1912.
Assistant State Club Leader: Harriet M. Woodward, B.Sc., Framingham Normal, School, 1922.

E. Miscellaneous.

Matron, Infirmary: Mrs. Mary Macrae.
Curator, Department of Chemistry: Ural V. Martin.

Table II. — Speakers for the Year.

A. Speakers at Assembly for the Year ending Nov. 30, 1924.

1923	
Dec. 6.	Mr. Homer B. Hurlbert, Springfield.
Dec. 13.	Mr. Ray Stannard Baker, Amherst.
1924	
Jan. 2.	Mr. Samuel T. Dana, Amherst.
Jan. 9.	Mr. William G. Baxter, Hartford, Conn.
Jan. 16.	Dr. Harry F. Ward, New York City.
Jan. 23.	Mr. Henry Bond, Brattleboro, Vt.
Jan. 30.	Prof. James W. Crook, Amherst.
Feb. 6.	Prof. Irving Fisher, New Haven, Conn.
Feb. 13.	Student Forum.
Feb. 20.	Dean Edward M. Lewis, M. A. C.
Feb. 27.	Freshman-Sophomore Debate.
Mar. 5.	Prof. Thomas E. Elder, Mt. Hermon.
Mar. 19.	President Ralph D. Hetzel, Durham, N. H.
Mar. 26.	Mayor Edward J. Woodhouse, Northampton.
Apr. 2.	Rev. Edwin B. Robinson, Holyoke.
Apr. 9.	Prof. Robert Frost, Amherst.
Apr. 16.	Dr. Charles F. Remer, Cambridge.
Apr. 23.	Dr. Alfred Sze, China.
Apr. 30.	Mr. Frank Morrison, Washington, D. C.
May 14.	Student Forum.
May 21.	Burnham Declamation Contest.
Sept. 17.	Opening Assembly.

1924

Sept. 25. Acting President Edward M. Lewis.
Oct. 2. Rev. Edwin B. Robinson, Holyoke.
Oct. 9. Hon. George D. Chamberlain, Springfield.
Oct. 16. Mr. Roland A. Gibson, New York City.
Oct. 23. Mayor Edward J. Woodhouse, Northampton.
Oct. 30. Mrs. Lucia Ames Mead, Brookline.
Nov. 6. Student Forum.
Nov. 13. Motion Pictures, Massachusetts Forestry Association.
Nov. 20. President George D. Olds, Amherst.

B. Speakers at Sunday Chapel for Year Ending Nov. 30, 1924.

1923

Dec. 9. Dr. Samuel A. Eliot, Boston.
Dec. 16. Dr. B. H. Lockhart, Manchester, New Hampshire.

1924

Jan. 6. Bishop Edwin H. Hughes, Malden.
Jan. 13. Rev. S. Ralph Harlow, Northampton.
Jan. 20. Rev. John Haynes Holmes, New York City.
Jan. 27. Rev. John C. Seymour, Holyoke.
Feb. 3. Mr. Alfred E. Stearns, Andover.
Feb. 10. Dr. D. Brewer Eddy, Boston.
Feb. 17. Rev. Barrett P. Tyler, Brookline.
Feb. 24. Dr. Sidney E. Goldstein, New York City.
Mar. 2. Rev. Alfred Grant Walton, Stamford, Conn.
Mar. 9. Rev. Marshall Dawson, Storrs, Conn.
Mar. 23. Rev. John Herman Randall, New York City.
Mar. 30. Rev. Frank W. Padelford, New York City.
Apr. 6. Pres. John M. Thomas, State College, Pa.
Apr. 13. Prof. Rufus M. Jones, Haverford, Pa.
Apr. 20. Rev. Nehemiah Boynton, New York City.
Apr. 27. Rev. John B. Hanna, M. A. C.
Nov. 2. Bishop Francis J. McConnell, Pittsburgh, Pa.
Nov. 9. Rev. John Howard Melish, Brooklyn, New York.
Nov. 16. Bishop Thomas F. Davies, Springfield, Mass.
Nov. 23. Rev. John Herman Randall, New York City.

TABLE III. — ATTENDANCE.

	Registration Nov. 1, 1923.			Registration Nov. 1, 1924.		
	Men.	Women.	Total.	Men.	Women.	Total.
A. In Work of College Grade.						
Graduate Students	58	5	63	53	9	62
Senior Class	87	7	94	79	4	83
Junior Class	71	4	75	99	14	113
Sophomore Class	120	17	137	100	10	110
Freshman Class	112	13	125	152	31	183
Special Students	10	7	17	9	11	20
Totals	458	53	511	496	75	571
B. Short Course Enrollment.						
Two-Year Course, second year	84	5	89	60	8	68
Two-Year Course, first year	68	12	80	85	9	94
Vocational Poultry Course	4	–	4	–	–	–
Two-Year Course, special students	–	–	–	1	1	2
Totals	156	17	173	146	18	164
C. Other Short Course Enrollment.						
School for Country Clergymen	32	2	34	–	–	–
Winter School	68	16	84	72	11	83
Summer School	17	110	127	55	89	144
School for Florists	7	4	11	–	–	–
Totals	124	132	256	127	100	227

D. Convention Registration.	1923.	1924.
Polish Farmers' Day	100	200
Farmers' Week and Annual Poultry Convention	2,500	3,000
Junior Boys' and Girls' Prize Winners' Camp	75	100
Extension Workers' Conference	85	100
Sheep Breeders' Conference	75	–
Middlesex County Club Champions	200	–
Feed Dealers' Conference	–	40
Tri-State Conference on Fruit Growing	100	–
Hampden County Club Members	200	100
Bankers' Conference	–	20
Women's Clubs	–	80
Lawn Day	–	30
Greenkeepers' Day	–	35
Boys' Camp	–	50
Totals	3,330	3,755

Table IV. — Legislative Budget, 1924.

Items.	Requested, 1924.	Appropriated.
Tunnel for steam line from power plant to Stockbridge	$39,000	–
Horticultural Manufactures, laboratory and equipment	60,000	–
Miscellaneous buildings and improvements	34,650	$5,650
Addition to Rural Engineering Building and Equipment	17,500	15,000
Roads and Walks	10,000	1,000
Buildings for Market Garden Field Station at Waltham	25,000	25,000[1]
Totals	$186,150	$46,650

[1] Subject to sale of Lexington plant at $25,000.

Table V. — Current Account, State Funds.

	Requested 1924.	Appropriated 1924.	Deficiency Appropriation (Balance from 1923).	Expended 1924.	Balance.
Personal Services:					
Administration	$38,635	$39,600	–	$37,314 73	$2,285 27
Instruction	205,069	196,000	–	192,016 04	3,983 96
General Maintenance	127,000	123,000	$520 26	127,820 45	—3,700 19
General Maintenance Emergency	–	600	–	–	–
Experiment Station	87,935	75,000	141 58	74,699 03	442 55
Extension Service	55,788	48,525	54 59	48,711 99	—132 40
Market Garden	6,000	6,000	–	5,427 42	572 58
Short Courses	60,357	58,500	–	58,008 24	491 76
Travel, Office and other Expenses	47,375	42,500	804 76	42,237 23	1,067 53
Teaching, lab. supplies and equip.	56,000	54,000	382 62	55,321 52	61 10
Teaching, lab. supplies and equip. emergency	–	1,000	–	–	–
Experiment Station supplies, equip. and publications	17,680	15,000	631 68	15,613 23	18 45
Experiment Station travel and office expenses	4,370	4,000	78 28	3,750 97	327 31
Extension Service supplies, equip., travel, etc.	40,400	33,200	363 23	34,265 80	—702 57
Short Courses	15,350	12,000	512 75	11,958 60	554 15
Heat, light and power	65,000	65,000	223 07	44,081 40	21,141 67
Farm and Grounds	20,000	20,000	1,450 96	17,938 66	3,512 30
Repairs, Ordinary	25,000	25,000	452 24	25,475 22	—22 98
Replacements	27,500	20,000	1,014 25	22,368 52	—1,354 27
Market Gardening	4,400	4,200	115 35	4,813 09	—497 74
Fertilizer Law Control	13,500	13,500	13 20	13,387 60	125 60
Poultry Disease Law	8,000	8,000	54 34	8,074 20	—19 86
Milk-testing inspection law	600	600	–	510 01	89 99
Trustees' Expenses	1,200	1,200	15 95	1,193 03	22 92
Printing Reports	2,000	2,000	782 09	2,257 61	524 48
Commercial Feedstuffs	9,500	9,000	18 20	9,095 30	—77 10
Emergency Fund	10,000	–	–	–	–
	$948,659	$877,425	$7,629 40	$856,339 89	$28,714 51
Emergency Fund appropriated but not used	–	3,400	–	–	–

Table VI. — Statistics of Freshmen entering Massachusetts Agricultural College, September, 1924.

A. Home Addresses of Students (classified by Towns and Cities).

Abington	1	Hadley	1	Plainfield, Ct.	1
Amherst	10	Hampden	1	Quincy	4
Arlington	3	Hatfield	1	Reading	1
Attleboro	1	Haverhill	1	Red Bank, N. J.	1
Ayer	1	Hingham	2	Rockland	2
Bellingham	1	Holden	3	Salem	1
Belmont	3	Holliston	1	Shelburne	1
Berlin	2	Holyoke	12	Sherborn	1
Bernardston	1	Hopedale	1	Shirley	1
Beverly	2	Keene, N. H.	1	Somerville	1
Boston	5	Lafayette, Ind.	1	Southborough	1
Bridgewater	1	Lawrence	1	South Hadley	1
Brockton	2	Lenox	1	Springfield	5
Brookfield	1	Littleton	3	Sterling	1
Cambridge	2	Longmeadow	1	Stoneham	1
Chelsea	2	Lowell	3	Stow	1
Cheshire	1	Lynn	1	Sutton	1
Chicopee	2	Manchester, N. H.	1	Swampscott	1
Closter, N. J.	1	Marion	1	Switzerland	1
Colrain	1	Marshfield	1	Taunton	2
Conway	3	Maynard	1	Templeton	1
Dalton	1	Medfield	1	Turner, Me.	1
Danvers	2	Millis	2	Utica, N. Y.	1
Detroit, Mich.	1	Monson	1	Waltham	3
East Longmeadow	1	Montague	3	Ware	1
Everett	1	Natick	1	Watertown	1
Fair Haven, Vt.	1	New Bedford	1	Wellesley	2
Fall River	2	Newburyport	1	West Brookfield	1
Falmouth	1	Newton	1	Westfield	2
Framingham	3	Norfolk	1	West Springfield	2
Georgetown	1	North Adams	1	Westwood	1
Grafton, Vt.	1	Northampton	5	Weymouth	1
Great Barrington	2	Northbridge	1	Wilmington	1
Greenfield	5	Norton	2	Winchester	1
Groveland	1	Philadelphia, Pa.	1	Worcester	4
Guilford, Vt.	1	Pittsfield	1		

B. Home Addresses (classified by States and Countries).

	Number.	Per Cent.		Number.	Per Cent.
Connecticut	1	.54	New York	1	.54
Indiana	1	.54	Pennsylvania	1	.54
Maine	1	.54	Switzerland	1	.54
Massachusetts	170	92.39	Vermont	3	1.63
Michigan	1	.54			
New Hampshire	2	1.09		184	99.98
New Jersey	2	1.09			

C. Home Addresses (classified by Counties of Massachusetts).

	Number.	Per Cent.		Number.	Per Cent.
Barnstable	1	.59	Middlesex	35	20.59
Berkshire	7	4.12	Norfolk	13	7.65
Bristol	8	4.71	Plymouth	10	5.88
Essex	12	7.06	Suffolk	7	4.12
Franklin	14	8.23	Worcester	17	10.00
Hampden	32	18.82			
Hampshire	14	8.23		170	100.00

D. Nativity of Parents.

	Number.	Per Cent.
Neither parent foreign born	130	70.65
Both parents foreign born	34	18.48
Father (only) foreign born	14	7.61
Mother (only) foreign born	6	3.26
	184	100.00

E. Education of Father.

	Number.	Per Cent.
Common School	70	38.04
High School	56	30.44
Business School	16	8.69
College or University	34	18.48
No statistics	8	4.35
	184	100.00

F. Occupation of Father.

Agriculture and Horticulture	40	21.74
Artisans	36	19.56
Business	55	29.89
Deceased or no statistics	14	7.61
Miscellaneous	25	13.59
Professional	14	7.61
	184	100.00

G. Intended Vocation of Student.

Agriculture or Horticulture (practical)	35	19.02
Agriculture or Horticulture (professional)	72	39.13
Professions	12	6.52
Miscellaneous	31	16.85
Undecided or no statistics	28	15.22
Home economics	6	3.26
	184	100.00

H. Farm Experience.

Brought up on a farm	54	29.35
Not brought up on a farm and having no or practically no farm experience	67	36.41
Not brought up on a farm, but having had some farm experience	63	34.24
	184	100.00

I. Miscellaneous Statistics.

Average Age (Years)	18.65

REPORT OF THE TREASURER.

For the Fiscal Year ending Nov. 29, 1924.

Balance Sheet.

		Dr.	Cr.
1923			
Dec. 1.	To balance on hand	$37,396 08	
1924			
Nov. 29.	To departmental income	163,214 32	
Nov. 29.	To receipts from State Treasurer	789,590 55	
Nov. 29.	To refunds to State Treasurer	1,238 57	
Nov. 29.	To bills paid by State Treasurer	92,576 80	
Nov. 29.	To receipts from U. S. Treasurer	121,921 57	
Nov. 29.	To November schedule in transit	126,833 66	
Nov. 29.	Refunds transferred to State Treasurer		$1,238 57
Nov. 29.	Expenditures for fiscal year		1,130,933 44
Nov. 29.	Income transferred to State Treasurer		163,214 32
Nov. 29.	Balance on hand		37,385 22
		$1,332,771 55	$1,332,771 55

Statement of Legislative Apportionment and Expenditures for Fiscal Year ending Nov. 29, 1924, and Apportionment Requested for 1925.

	Apportionment for Last Fiscal Year.		Expenditures.		Requested Apportionment for New Fiscal Year.	
College:						
Personal services	$359,120 26		$357,151 22		$371,646 00	
Maintenance	209,592 08		191,118 83		211,000 00	
		$568,712 34		$548,270 05		$582,646 00
Experiment Station:						
Personal services	$75,141 58		$74,699 03		$82,650 00	
Maintenance	19,709 96		19,364 20		22,350 00	
		94,851 54		94,063 23		105,000 00
Extension Service:						
Personal services	$48,579 59		$48,711 99		$55,975 00	
Maintenance	33,563 23		34,265 80		35,750 00	
		82,142 82		82,977 79		91,725 00
Short Courses:						
Personal services	$58,500 00		$58,008 24		$62,738 00	
Maintenance	12,512 75		11,958 60		11,400 00	
		71,012 75		60,966 84		74,138 00
Market Garden Field Station:						
Personal services	$6,000 00		$5,427 42		$7,000 00	
Maintenance	4,315 35		4,813 09		5,000 00	
		10,315 35		10,240 51		12,000 00
Trustees travel	$1,215 95		$1,193 03		$1,200 00	
Printing reports	2,782 09		2,257 61		2,000 00	
Commercial feedstuffs	9,018 20		9,095 30		9,000 00	
Totals		13,016 24		12,545 94		12,200 00
Fertilizer law	$13,513 20		$13,387 60		$14,000 00	
Poultry law	8,054 34		8,074 20		8,500 00	
Milk testing law	600 00		510 01		600 00	
Totals		22,167 54		21,971 81		23,100 00
Replacements	$21,014 25	21,014 25	$22,368 52	22,368 52	$25,000 00	25,000 00
Emergency					10,000 00	10,000 00
Totals		$883,232 83		$862,404 69		$935,809 00
Balance unexpended		–		20,828 14		–
		–		$883,232 83		–

Cash Statement.

	Other Funds.	State Funds.	Totals.
Balance December 1, 1923	$37,396 08	–	$37,396 08
Receipts.			
College receipts from students and others			26,606 71
Tuition	–	$5,995 44	
Laboratory fees	–	6,398 91	
Rent	–	14,212 36	
Departmental Sales			74,695 59
Products	–	68,250 42	
Miscellaneous	–	6,445 17	
Experiment Station			15,580 69
Cranberry receipts	–	6,341 67	
Chemical receipts	–	546 98	
Miscellaneous	–	8,692 04	
Extension Service			908 21
Correspondence	–	625 85	
Miscellaneous	–	282 36	
Short Courses			4,526 16
Students' fees	–	4,118 16	
Winter School	–	408 00	
Miscellaneous	–	–	
Market Garden Field Station			557 38
Produce	–	557 38	
Feed Law	–	18,002 00	18,002 00
Fertilizer Law	–	15,789 50	15,789 50
Milk Testing Law	–	840 87	840 87

	Other Funds.	State Funds.	Totals.
Poultry Disease Law	–	$5,707 21	$5,707 21
Treasurer of the Commonwealth			789,590 55
Maintenance	–	706,742 04	
Special Appropriations	–	77,747 69	
Endowment	$3,313 32		
Department of Education	1,787 50		
Federal Government			121,921 57
Land Grant of 1862	7,300 00		
Hatch Fund of 1887	15,000 00		
Morrill Fund of 1890	16,666 67		
Adams Fund of 1906	15,000 00		
Nelson Fund of 1907	16,666 66		
Smith Lever Fund of 1914	31,234 74		
Short Courses, Federal Project	20,053 50		
November schedules in transit	–	126,833 66	126,833 66
Bills paid by State Treasurer	–	92,576 80	92,576 80
	$164,418 47	$1,167,114 51	$1,331,532 98

Payments.

College expenses			$594,166 70
Personal services	$45,896 65	$357,151 22	
Maintenance	–	191,118 83	
Experiment Station			124,988 23
Personal services	30,925 00	74,699 03	
Maintenance	–	19,364 20	
Extension Service			113,214 78
Personal services	29,865 52	48,711 99	
Maintenance	371 47	34,265 80	
Short Courses			89,941 45
Personal services	10,494 18	58,008 24	
Maintenance	9,480 43	11,958 60	
Market Garden Field Station			10,240 51
Personal services	–	5,427 42	
Maintenance	–	4,813 09	
Trustees Travel	–	1,193 03	1,193 03
Printing reports	–	2,257 61	2,257 61
Replacements	–	22,368 52	22,368 52
Commercial feedstuffs	–	9,095 30	9,095 30
Fertilizer law	–	13,387 60	13,387 60
Milk Testing Law	–	510 01	510 01
Poultry Disease Law	–	8,074 20	8,074 20
Special appropriations			140,436 21
1923 Chemistry Laboratory	–	109,110 47	
1923 Tenement House	–	5,756 43	
1923 Improvements at Tillson Farm	–	829 45	
1923 Tool shed and Garage	–	975 58	
1923 New Walks	–	260 06	
1923 Road Improvements	–	8 39	
1923 Replacement of live stock	–	2,932 72	
1924 Roads and Walks	–	739 17	
1924 Miscellaneous Improvements	–	5,650 00	
1924 Rural Engineering Building	–	12,178 30	
1924 Market Garden Field Station	–	1,995 64	
Income	–	163,214 32	163,214 32
Refunds to State Treasurer	–	1,059 29	1,059 29
Balance	37,385 22	–	37,385 22
	$164,418 47	$1,167,114 51	$1,331,532 98

Current Account, 1924.

Disbursements and Receipts.

Accounts.	Disbursements from Nov. 30, 1923, to Nov. 29, 1924.	Receipts from Nov. 30, 1923, to Nov. 29, 1924.	Apportionment for year ending Nov. 29, 1924.	Balance to Credit.
Dean's Office	$762 94	$0 39	$814 70	$51 76
Executive Order	9,243 35	3 70	11,202 15	1,958 80
President's Office	1,705 31	3 76	2,073 07	367 76
Registrar's Office	617 51	–	750 50	132 99
Salaries	37,314 73	–	39,600 00	2,285 27
Treasurer's Office	1,835 22	94 96	2,002 20	166 98
Maintenance, Academic:				
Agricultural Economics	448 82	1 00	550 00	101 18
Agricultural Education	518 41	–	400 30	—118 11
Agronomy	1,206 36	188 50	1,214 00	7 64
Animal Husbandry	575 34	102 50	562 65	—12 69
Beekeeping	390 56	9 45	400 00	9 44
Botany	1,538 66	680 10	1,627 57	88 91
Chemistry	6,043 19	1,957 00	5,707 20	—335 99
Dairying	31,634 11	22,770 04	32,572 73	938 62
Domestic Science	1,831 46	77 25	1,410 56	—420 90
Economics and Sociology	4 74	–	100 75	96 01
Entomology	1,276 78	157 00	1,301 00	24 22
Farm Management	409 31	49 50	509 29	99 98
Floriculture	7,874 63	2,755 87	7,810 21	—64 42
Forestry	352 40	104 50	407 88	55 48
Freshman Agriculture	476 28	–	750 00	273 72
General Agriculture	2,778 14	–	2,644 85	—133 29
Horticultural Manufactures	3,562 34	551 09	3,654 78	92 44
Hospital	4,143 76	1,122 20	3,314 92	—828 84
Landscape Gardening	553 77	597 50	621 03	67 26
Language and Literature	296 60	186 00	308 10	11 50
Mathematics	364 70	39 00	400 00	35 30
Microbiology	2,241 41	308 61	2,400 00	158 59
Military Science	1,734 38	35 40	1,702 45	—31 93
Mount Toby	3,555 42	1,756 80	3.551 20	—4 22
Physical Education	1,457 17	–	1,500 00	42 83
Physics	663 00	189 00	755 50	92 50
Pomology	6,788 30	3,016 77	5,718 18	—1,070 12
Poultry Husbandry	16,613 90	16,150 65	14,540 18	—2,073 72
Rural Engineering	905 46	80 50	905 11	— 35
Rural Sociology	179 63	–	200 00	20 37
Vegetable Gardening	6,541 60	2,535 47	6.607 25	65 65
Veterinary Science	2,319 58	92 00	2,307 58	—12 00
Women's Dormitory	3,518 15	–	2,747 90	—770 25
Zoölogy and Geology	546 95	485 00	600 00	53 05
Maintenance, General:				
Farm	16,333 22	2,050 99	13,594 92	—2,738 30
General Horticulture	8,916 87	122 46	9,055 16	138 29
Graduate School	133 29	–	200 00	66 71
Grounds	9,600 22	–	9,546 53	—53 69
Library	7,649 91	93 35	8,143 10	493 19
Live stock	26,299 26	16,915 71	25,037 91	—1,261 35
General Expense	1,184 63	1,172 71	–	–
Operating and Maintenance	122,171 56	24,845 57	140,492 90	18,321 34
Replacements	22,564 52	–	21,014 25	—1,550 27
Endowment fund	10,613 32	10,613 32	10,613 32	3,650 00
Instruction:				
Salaries	192,016 04	–	196,000 00	3,983 96
United States Treasurer, Morrill Fund	16,666 67	16,666 67	16,666 67	9,722 22
United States Treasurer, Nelson Fund	16,666 66	16,666 66	16,666 66	9,722 21
State Treasurer, Account of schedules	–	570,638 57	–	–
Income to State Treasurer	101,302 30	–	–	–
	$716,942 84	$715,887 52	$633,277 21	$41,915 73
Less Refunds	1,055 32	–	–	–
	$715,887 52	$715,887 52	–	–
Balance beginning fiscal year December 1, 1923	–	23,094 43	–	–
Balance on hand November 29, 1924	23,094 43	–	–	–
	$738,981 95	$738,981 95	–	–

College Accounts.

Summary.

	Disbursements.	Receipts.
Cash on hand Dec. 1, 1923	–	$23,094 43
Institution receipts Nov. 29, 1924	–	101,302 30
State Treasurer's receipts Nov. 29, 1924	–	570,638 57
United States Treasurer's receipts Nov. 29, 1924	–	33,333 33
State Treasurer, Department of Education	–	1,787 50
State Treasurer, Endowment fund	–	10,613 32
Total Disbursements	$616,535 22	–
Receipts turned in to State Treasurer	101,302 30	–
	$717,837 52	$740,769 45
Bills receivable Dec. 1, 1923, deducted	–	11,029 42
Bills payable Dec. 1, 1923, deducted	1,961 24	–
	$715,876 28	$729,740 03
Bills receivable Nov. 29, 1924	–	6,668 97
Bills payable Nov. 29, 1924	1,929 04	–
Balance	18,603 68	–
	$736,409 00	$736,409 00

NET COSTS OF THE DEPARTMENTS.

DEPARTMENT.	Salaries.	Labor.	Maintenance.	Total.	Receipts.	Balance.
Dean's Office	$4,125 01	$394 34	$368 60	$4,887 95	$0 39	$4,887 56
Executive Order	–	459 60	8,783 75	9,243 35	3 70	9,239 65
President's Office	16,798 40	291 35	1,413 96	18,503 71	3 76	18,499 95
Registrar's Office	–	103 66	513 85	617 51	–	617 51
Treasurer's Office	16,391 32	273 43	1,561 79	18,226 54	94 96	18,131 58
Totals	$37,314 73	$1,522 38	$12,641 95	$51,479 06	$102 81	$51,376 25
Instruction and Maintenance.						
Agricultural Economics	$9,310 00	$43 21	$405 61	$9,758 82	$1 00	$9,757 82
Agricultural Education	5,441 25	244 13	274 28	5,959 66	–	5,959 66
Agronomy	7,615 00	695 55	510 81	8,821 36	188 50	8,632 86
Animal Husbandry	3,750 00	67 75	507 59	4,325 34	102 50	4,222 84
Beekeeping	2,205 00	73 06	317 50	2,595 56	9 45	2,586 11
Botany	12,617 79	405 79	1,132 87	14,156 45	680 10	13,476 35
Chemistry	15,867 67	1,450 83	4,592 36	21,910 86	1,957 00	19,953 86
Dairying	7,320 00	6,589 65	25,044 46	38,954 11	22,770 04	16,184 07
Dean's Office	2,952 50	–	–	2,952 50	–	2,952 50
Domestic Science	7,762 50	224 15	1,607 31	9,593 96	77 25	9,516 71
Economics and Sociology	1,532 67	–	4 74	1,537 41	–	1,537 41
Entomology	10,697 00	813 30	463 48	11,973 78	157 00	11,816 78
Farm	–	24,685 74	17,946 74	42,632 48	18,966 70	23,665 78
Farm Management	5,500 00	53 74	355 57	5,909 31	49 50	5,859 81
Floriculture	3,570 00	6,426 09	1,448 54	11,444 63	2,755 87	8,688 76
Forestry	2,620 00	204 57	147 83	2,972 40	104 50	2,867 90
Freshman Agriculture	214 93	215 80	260 48	691 21	–	691 21
General Agriculture	2,915 17	2,127 93	650 21	5,693 31	–	5,693 31
General Expense	–	2,767 43	—1,582 80	1,184 63	1,172 71	11 92
General Horticulture	10,303 84	5,483 38	3,433 49	19,220 71	122 46	19,098 25
Graduate School	–	–	133 29	133 29	–	133 29
Grounds	–	8,715 67	884 55	9,600 22	–	9,600 22
Horticultural Manufactures	5,550 00	1,614 98	1,947 36	9,112 34	551 09	8,561 25

Hospital	–	2,481 29	1,662 47	4,143 76	1,122 20	3,021 56
Landscape Gardening	4,582 32	–	553 77	5,136 09	597 50	4,538 59
Language and Literature	22,630 50	55 50	241 10	22,927 10	186 00	22,741 10
Library	9,202 58	2,142 10	5,507 81	16,852 49	93 35	16,759 14
Mathematics	11,250 00	236 92	127 78	11,614 70	39 00	11,575 70
Microbiology	11,173 10	777 95	1,463 46	13,414 51	308 61	13,105 90
Military	600 00	306 51	1,427 87	2,334 38	35 40	2,298 98
Mount Toby	–	3,423 58	131 84	3,555 42	1,756 80	1,798 62
Operating and Maintenance	–	33,335 09	88,836 47	122,171 56	24,845 57	97,325 99
Physical Education	10,530 00	513 05	944 12	11,987 17	–	11,987 17
Physics	6,924 19	233 60	429 40	7,587 19	189 00	7,398 19
Pomology	6,550 00	5,100 79	1,687 51	13,338 30	3,016 77	10,321 53
Poultry Husbandry	9,779 44	5,329 04	11,284 86	26,393 34	16,150 65	10,242 69
Registrar's Office	2,041 09	–	–	2,041 09	–	2,041 09
Replacements	–	–	22,564 52	22,564 52	–	22,564 52
Rural Engineering	5,700 00	429 89	475 57	6,605 46	80 50	6,524 96
Rural Sociology	3,685 00	–	179 63	3,864 63	–	3,864 63
Vegetable Gardening	2,150 00	5,113 66	1,427 94	8,691 60	2,535 47	6,156 13
Veterinary	6,349 15	1,160 79	1,158 79	8,668 73	92 00	8,576 73
Women's Dormitory	–	2,715 92	802 23	3,518 15	–	3,518 15
Zoölogy and Geology	5,070 00	141 40	405 55	5,616 95	485 00	5,131 95
Totals	$235,962 69	$126,399 83	$201,798 96	$564,161 48	$101,199 49	$462,961 99
Grand totals	$273,277 42	$127,922 21	$214,440 91	$615,640 54	$101,302 30	$514,338 24

$10,613 32	Land Grant and Endowment
33,333 33	Morrill & Nelson
192,016 04	Instruction
37,314 73	Administration
$273,277 42	
1,950 00	Dept. of Education
$275,227 42	

College Expenses as per Cash Statement:

$594,166 70
22,368 52
$616,535 22

Total of this Statement:

$615,640 54	
1,950 00	Dept. of Education
$617,590 54	
1,055 32	Refunds
$616,535 22	

Expense Operating and Maintenance.

	Salaries and Labor.	Fuel and Water.	Repairs.	Equipment.	Miscellaneous.	Totals.
General:						
General Superintendent	$2,078 33	–	–	–	–	$2,078 33
Office	1,056 15	–	–	–	$117 25	1,173 40
Power Plant:						
Heat	13,730 74	$50,906 16	$3,458 24	–	324 53	68,419 67
Light	6,510 34	–	207 47	–	89 43	6,807 24
Tools	–	–	–	$1,387 26	–	1,387 26
Amherst Water Company	–	3,615 32	–	–	–	3,615 32
Night watchman	2,408 90	–	–	–	40 88	2,449 78
Mail service	424 17	–	–	–	–	424 17
Water mains	–	–	145 77	–	–	145 77
Steam mains	–	–	1,122 85	–	–	1,122 85
Electric light circuit	–	–	1,044 08	–	–	1,044 08
Freight and Express	–	–	–	–	2,365 99	2,365 99
Telephone	–	–	–	–	2,193 21	2,193 21
Truck	–	–	–	–	793 68	793 68
Miscellaneous sundry	–	–	35 23	–	185 15	220 38
Sewers and cesspools	–	–	243 31	–	–	243 31
Walks and drives	–	–	137 89	–	–	137 89
Emergency maintenance	–	–	1,566 88	–	–	1,566 88
Expert Service:						
Architect	2,334 02	–	–	–	–	2,334 02
Auditors	250 00	–	–	–	–	250 00
Fire department	–	–	–	–	244 03	244 03
Totals	$28,792 65	$54,521 48	$7,961 72	$1,387 26	$6,354 15	$99,017 26

Expense Operating and Maintenance — *Continued.*

College Buildings.	Sundry.	Electric Repairs.	Plumbing Repairs.	Heat Repairs.	C. & M. Repairs.	Janitor.	Totals.
Adams Hall	–	$93 21	$143 23	$51 40	$64 10	–	$351 94
Apiary	–	3 02	7 66	24 23	50 69	–	85 60
Cashier's House	–	2 35	57	–	243 70	–	246 62
Clark Hall	–	29 57	34 02	12 89	88 31	–	164 79
Cold Storage Laboratory	–	–	1 63	–	–	–	1 63
Dairy Barn and Storage	–	30 71	32 48	31 37	355 22	–	449 78
Draper Hall	$241 42	170 76	854 91	238 98	1,920 33	$434 00	3,860 40
Drill Hall and Gun Shed	–	2 84	49 13	6 15	135 43	–	193 55
Durfee Glass House (old)	–	–	28	13 62	12 18	–	26 08
Durfee Glass House (new)	–	–	–	14 93	41 16	–	56 09
Farm Bungalow No. 1	–	–	14 34	16 51	10 64	–	41 49
Farm Bungalow No. 2	–	–	–	–	52 18	–	52 18
Farm Bungalow No. 3	–	–	–	–	52 18	–	52 18
Farm House No. 1	–	28 03	38 94	16 41	92 90	–	176 28
Farm Bull Pens and Fence	–	–	5 03	–	11 75	–	16 78
Fernald Hall	–	13 76	84 33	123 64	279 93	–	501 66
Flint Laboratory	–	12 15	60 55	59 57	438 01	–	570 28
French Hall	–	195 58	58 56	50 96	107 01	–	412 11
Goessmann Laboratory	–	–	8 02	8 03	–	–	16 05
Grinnell Arena	–	–	3 20	6 43	39 73	–	49 36
Harlow House	–	–	10 53	–	5 53	–	16 06
Horse Barn	–	–	4 87	–	17 38	–	22 25
Head of Division of Horticulture	–	27 64	38 34	–	396 90	–	462 88
Horticultural Barn	–	1 40	3 96	2 03	88 32	–	95 71
Horticultural Garage	–	–	–	–	56	–	56
Horticultural Tool Shed	–	–	60	–	7 30	–	7 90
Hospital	10 29	5 25	29 03	25 47	623 55	–	693 59
Jewett House and Barn	19 21	67	2 17	–	236 49	–	258 54
Mathematical Building	–	1 34	9 24	10 33	33 17	–	54 08
Memorial Hall	413 82	48 23	32 03	23 06	74 48	2,035 57	2,627 19
Microbiology Building	–	8 36	38 61	71 42	285 31	–	403 70
North Dormitory	–	118 11	469 66	135 98	166 27	1,015 98	1,906 00
Paige Laboratory and Stable	–	1 55	127 10	34 60	60 25	–	223 50
Physics Laboratory	–	–	9 84	29 15	9 66	–	48 65
Piggery	–	1 25	4 43	18 70	83 09	–	107 47
Poultry departments:							
Poultry No. 1	–	3 26	14 41	8 23	136 50	–	162 40
Poultry No. 2	–	–	3 75	–	62 12	–	65 87
Poultry No. 3	–	–	–	–	7 88	–	7 88
Poultry No. 8	–	–	–	–	46 26	–	46 26
Poultry No. 9	–	–	–	–	46 26	–	46 26
Poultry No. 12	–	–	–	–	46 27	–	46 27

Expense Operating and Maintenance — *Concluded.*

College Buildings.	Sundry.	Electric Repairs.	Plumbing Repairs.	Heat Repairs.	C. & M. Repairs.	Janitor.	Totals.
Power Building	–	$27 50	$71 72	$127 53	$192 33	$369 30	$788 38
President's House	$19 94	58 75	33 82	30 66	254 28	–	397 45
Rural Engineering Building	–	1 25	8 67	7 88	36	–	18 16
Sheep Barn	–	1 25	64	–	252 27	–	254 16
South Dormitory	–	209 09	202 03	102 49	445 88	978 81	1,938 30
Stable for Cavalry Unit	–	4 23	26 70	5 00	59 43	–	95 36
Stockbridge Hall	–	109 39	48 14	129 46	170 45	–	457 44
Agronomy Greenhouse and storage	–	–	22 35	20 58	123 13	–	166 06
Stockbridge House	–	–	19 49	–	4 75	–	24 24
Stone Chapel	58 25	43 70	32 05	6 65	67 75	–	208 40
Vegetable Plant House	–	2 78	–	78 24	189 58	–	270 60
Waiting Station	–	–	–	–	46 40	–	46 40
Wilder Hall	–	16 31	41 22	19 90	79 92	–	157 35
Young Stock Barns	–	6 70	10 96	65	210 65	–	228 96
East Experiment Station Building	–	4 99	4 82	57 11	17 27	–	84 19
East Experiment Station Barn	–	30 09	–	15 25	745 04	–	790 38
West Experiment Station Building	–	7 14	45 65	39 38	103 87	–	196 04
West Experiment Station Barn	–	3 75	83 26	18 19	643 57	–	748 77
Everson House	–	7 52	70	–	271 26	–	279 48
Tillson House and barn	–	–	–	–	205 60	–	205 60
Brooks House	39 21	1 21	58 46	–	12 43	–	111 31
East Experiment Station Greenhouse	–	52 00	17 05	17 04	690 19	–	776 28
West Experiment Station Creamery	–	–	3 00	–	280 12	–	283 12
Totals	$802 14	$1,386 69	$2,926 18	$1,710 10	$11,495 53	$4,833 66	$23,154 30
							99,017 26
							$122,171 56

Farm Disbursements.

	Repairs.	Labor.	Equipment.	Feed.	Supplies.	Sundry.	Bedding.	Fertilizer.	Seeds.	Improvements.	Totals.
Dairy Cattle	–	$6,412 91	$93 91	$1,775 19	$4,884 96	$1,612 28	–	–	–	–	$14,779 25
Horses	–	2,077 11	7 73	100 60	1,227 86	174 83	–	–	–	–	3,588 13
Sheep	–	1,343 22	5 84	49 12	281 99	108 25	–	–	–	–	1,788 42
Swine	–	1,395 01	3 33	290 16	414 86	47 83	–	–	–	–	2,151 19
Supplies	–	503 01	–	2,049 31	–	–	$1,439 95	–	–	–	3,992 27
Teams	–	—190 49	117 30	–	–	309 67	–	–	–	–	236 48
Field Crops	–	4,976 28	–	–	7 20	49 39	–	$660 09	$417 76	–	6,110 72
Tools and Machinery	$867 41	478 77	47 20	–	576 59	–	–	–	–	–	1,969 97
Miscellaneous	–	7,689 92	–	–	48 24	106 36	–	–	–	$171 53	8,016 05
Totals	$867 41	$24,685 74	$275 31	$4,264 38	$7,441 70	$2,408 61	$1,439 95	$660 09	$417 76	$171 53	$42,632 48

Farm Credits.

	Wool.	Milk.	Stock.	Sundry.	Labor.	Field Crops.	Tools and Machinery.	Improvements.	Totals.
Dairy Cattle	–	$9,093 15	$5,317 18	$18 08	–	–	–	–	$14,428 41
Horses	–	–	156 27	10 00	–	–	–	–	166 27
Sheep	$245 86	–	809 59	–	–	–	–	–	1,055 45
Swine	–	–	1,230 58	–	–	–	–	–	1,230 58
Supplies	–	–	–	35 00	–	–	–	–	35 00
Teams	–	–	–	–	$76 58	–	–	–	76 58
Field Crops	–	–	–	–	–	$688 55	–	–	688 55
Tools and Machinery	–	–	–	–	–	–	–	–	–
Miscellaneous	–	–	–	–	133 79	–	–	$1,152 07	1,285 86
Totals	$245 86	$9,093 15	$7,513 62	$63 08	$210 37	$688 55	–	$1,152 07	$18,966 70

Agricultural Division.

Disbursements and Receipts.

	Disbursements.	Receipts.
Agronomy	$1,206 36	$188 50
Animal husbandry	575 34	102 50
Dairying	31,634 11	22,770 04
Farm	42,632 48	18,966 70
Farm management	409 31	49 50
Poultry husbandry	16,613 90	16,150 65
Rural engineering	905 46	80 50
Division totals	$93,976 96	$58,308 39

Summary.

	Dr.	Cr.
By total division receipts		$58,308 39
By bills receivable		4,673 60
By net apportionment		30,628 40
To total division disbursements	$93,976 96	
To bills payable	228 53	
Balance		595 10
	$94,205 49	$94,205 49

Inventory of Quick Assets.

	Nov. 30, 1923.	Nov. 29, 1924.
Inventory of produce	$16,370 55	$15,607 77
Inventory of cattle	22,855 00	27,635 00
Inventory of swine	1,481 00	1,395 00
Inventory of horses	3,775 00	5,775 00
Inventory of poultry	4,783 50	3,993 50
Inventory of sheep	2,020 00	2,210 00
	$51,284 55	$56,616 27

Horticultural Division.

Disbursements and Receipts.

	Disbursements.	Receipts.
Floriculture	$7,874 63	$2,755 87
Forestry	352 40	104 50
General Horticulture	8,916 87	122 46
Grounds	9,600 22	–
Horticultural Manufactures	3,562 34	551 09
Landscape Gardening	553 77	597 50
Mount Toby	3,555 42	1,756 80
Pomology	6,788 30	3,016 77
Vegetable Gardening	6,541 60	2,535 47
Division totals	$47,745 55	$11,440 46

Summary.

	Dr.	Cr.
By total division receipts		$11,440 46
By bills receivable		1,810 32
By net apportionment		35,531 76
To total division disbursements	$47,745 55	
To bills payable	21 68	
By balance	1,015 31	
	$48,782 54	$48,782 54

Inventory of Quick Assets.

	Nov. 30, 1923.	Nov. 29, 1924.
Floriculture	$2,700 00	$2,275 00
General horticulture (live stock)	1,140 00	1,265 00
Horticultural manufactures	295 00	532 00
Mount Toby	78 40	542 50
Pomology	575 00	1,500 00
Vegetable Gardening	547 00	584 50
	$5,335 40	$6,699 00

Experiment Station.

Disbursements and Receipts.

	Disbursements from Dec. 1, 1923, to Nov. 29, 1924.	Receipts from Dec. 1, 1923, to Nov. 29, 1924.	Apportionment for Year ending Nov. 29, 1924.	Balance to Credit.
Administration	$1,318 80	$5 43	$1,533 54	$214 74
Agricultural economics	867 35	–	913 16	45 81
Agronomy	2,042 29	–	2,040 00	—2 29
Botanical	2,894 99	–	2,967 91	72 92
Chemical	3,206 90	546 98	3,554 47	347 57
Cranberry	4,553 99	6,341 67	4,229 70	—324 29
Entomological	808 09	–	861 20	53 11
Farm Management	148 30	–	200 00	51 70
Freight and Express	181 80	–	175 00	—6 80
Library	1,044 25	–	1,020 24	—24 01
Meteorology	452 58	–	500 00	47 42
Microbiology	1,014 75	–	1,020 81	6 06
Pomology	2,869 41	2,407 13	2,978 20	108 79
Poultry	5,682 30	4,576 71	5,610 50	—71 80
Publications	1,729 64	–	1,789 52	59 88
Salaries	83,977 19	–	83,052 21	—924 98
Station Service	11,668 98	1,426 77	11,882 56	213 58
Veterinary	526 62	276 00	522 52	—4 10
Hatch Fund	–	15,000 00	–	–
Adams Fund	–	15,000 00	–	–
State Treasurer, account of schedules	–	94,063 23	–	–
Income remitted to State Treasurer	15,580 69	–	–	–
	$140,568 92	$139,643 92	$124,851 54	—$136 69
Balance beginning fiscal year December 1, 1923	–	4,275 00	–	–
Balance on hand November 29, 1924	3,350 00	–	–	–
	$143,918 92	$143,918 92	–	–

Summary.

	Disbursements.	Receipts.
Cash on hand Dec. 1, 1923	–	$4,275 00
Receipts from State Treasurer	–	94,063 23
Receipts from United States Treasurer	–	30,000 00
Receipts from other sources	–	15,580 69
Total Disbursements	$124,988 23	–
Receipts turned in to State Treasurer	15,580 69	–
	$140,568 92	$143,918 92
Bills receivable Dec. 1, 1923 deducted	–	1,273 14
Bills payable Dec. 1, 1923 deducted	329 96	–
	$140,238 96	$142,645 78
Bills receivable Nov. 29, 1924	–	2,498 37
Bills payable Nov. 29, 1924	53 59	–
Balance	4,851 60	–
	$145,144 15	$145,144 15

Extension Service.

Disbursements and Receipts.

Classification.	Disbursements.	Receipts.	Apportionment.	Balance.
Administration	$1,678 53	$102 55	$3,006 46	$1,327 93
Animal husbandry	823 62	–	800 00	—23 62
Clothing efficiency	1,961 26	–	2,003 17	41 91
Co-op. marketing	624 27	–	600 30	—23 97
Correspondence Courses	1,126 83	625 85	3,000 00	1,873 17
County Agents work	1,550 84	–	1,002 00	—548 84
Dairying	129 66	–	100 00	—29 66
Exhibits	822 97	–	700 40	—122 57
Extension Courses at College	3,088 42	–	1,501 06	—1,587 36
Extension schools	928 12	–	250 00	—678 12
Farm Management demonstration	795 39	23 50	1,200 00	404 61
Home economics	1,902 10	31 05	2,002 61	100 51
Home gardening	752 73	–	1,000 00	247 27
Household Management	476 59	90	–	—476 59
Horticultural Manufactures	2,209 19	99 04	1,500 60	—708 59
Injurious Insects	17 08	–	–	—17 08
Junior extension work	6,136 54	–	5,505 10	—631 44
Landscape extension	206 00	–	600 70	394 70
Lectures	343 71	–	100 00	—243 71
Library extension	128 66	–	150 00	21 34
Nutrition	745 13	–	1,400 00	654 87
Plant diseases	30 35	–	–	—30 35
Pomology	1,706 98	–	1,315 80	—391 18
Poultry husbandry	1,453 82	5 20	1,102 35	—351 47
Printing	4,123 89	20 12	3,922 33	—201 56
Personal services	48,711 99	–	48,579 59	—132 40
Rural Engineering	27 88	–	–	—27 88
Soils and Crops	479 21	–	800 35	321 14
State Treasurer, account of schedules	–	82,977 79	–	–
Income to State Treasurer	908 21	–	–	–
	$83,889 97	$83,886 00	$82,142 82	—$838 94
Less refund	3 97	–	–	–
	$83,886 00	$83,886 00	–	–

Summary.

	Disbursements.	Receipts.
Balance Dec. 1, 1923[1]	–	$9,086 41
Receipts Nov. 29, 1924	–	908 21
Received from State Treasurer	–	82,977 79
Received from United States Treasurer	–	31,234 74
Disbursements to Nov. 29, 1924[1]	$113,214 78	–
Receipts turned in to State Treasurer	908 21	–
	$114,122 79	$124,207 15
Bills receivable Dec. 1, 1923 deducted	–	23 32
Bills payable Dec. 1, 1923 deducted	58 84	–
	$114,063 95	$124,183 83
Bills receivable Nov. 29, 1924	–	63 22
Bills payable Nov. 29, 1924	5 12	–
Balance	10,177 98	–
	$124,247 05	$124,247 05

[1] Includes Federal Smith-Lever Fund.

Smith-Lever Fund (Federal).

	Disbursements.	Receipts.
Administration	$275 22	–
Home economics	18 13	–
Junior extension	35 72	–
Salaries	29,865 52	–
Vegetable gardening	42 40	–
State Treasurer	–	$31,234 74
	$30,236 99	$31,234 74
Balance beginning fiscal year Dec. 1, 1923	–	9,086 41
Balance on hand Nov. 29, 1924	10,084 16	–
Totals	$40,321 15	$40,321 15

Short Courses.

	Disbursements.	Receipts.	Apportionment.	Balance.
Agricultural economics	$32 44	–	$50 00	$17 56
Agronomy	503 80	$221 50	500 00	—3 80
Animal husbandry	67 96	100 50	100 00	32 04
Dairying	2,996 78	268 00	3,000 00	3 22
Domestic science	179 86	–	100 00	—79 86
Entomology	94 87	–	100 00	5 13
Farm Management	37 11	–	50 00	12 89
Floriculture	139 52	72 50	100 00	—39 52
Forestry	–	–	50 00	50 00
Horticulture	271 31	69 50	200 00	—71 31
Horticultural Manufactures	495 42	–	726 24	230 82
Library	136 27	–	125 00	—11 27
Microbiology	37 24	31 16	50 00	12 76
Personal services	58,008 24	–	58,500 00	491 76
Physical education	208 55	–	200 00	—8 55
Pomology	825 23	–	949 90	124 67
Poultry husbandry	702 67	271 50	600 00	—102 67
Rural engineering	740 42	275 50	850 00	109 58
Short Course Office	4,100 58	–	4,168 55	67 97
Treasurer's Office	248 26	–	289 10	40 84
Tuition	–	2,730 00	–	–
Vegetable gardening	140 31	78 00	303 96	163 65
Winter school registration	–	408 00	–	–
State Treasurer, account of schedules	–	69,966 84	–	–
Income to State Treasurer	4,526 16	–	–	–
Totals	$74,493 00	$74,493 00	$71,012 75	$1,045 91

Summary.

	Disbursements.	Receipts.
State appropriation	–	$71,012 75
Amount of receipts	–	4,526 16
Receipts transferred to State Treasurer	$4,526 16	–
Department expenditures	69,966 84	–
Balance unexpended	1,045 91	–
Totals	$75,538 91	$75,538 91

Market-Garden Field Station.

	Debit.	Credit.
Labor	$5,427 42	
Maintenance	4,813 09	
Totals	$10,240 51	
State appropriation		$10,315 35
Amount of Receipts		557 38
Amount of Receipts transferred to State Treasurer	$557 38	
Department expenditures	10,240 51	
Balance unexpended	74 84	
Totals	$10,872 73	$10,872 73

Special Appropriations.

	Date made.	Appropriations.	Amount Expended to Date.	Unexpended Balance.
Chemistry Laboratory	1922	$300,000 00	$294,385 78	$5,614 22
Tenement House	1923	8,000 00	8,000 00	–
Improvements at Tillson Farm	1923	5,000 00	5,000 00	–
Tool shed and Garage	1923	6,000 00	6,000 00	–
New walks	1923	2,500 00	2,500 00	–
Road Improvements	1923	8,000 00	8,000 00	–
Replacement of Live stock	1923	5,000 00	5,000 00	–
Roads and Walks	1924	1,000 00	739 17	260 83
Emergency needs	1924	5,000 00	–	5,000 00
Miscellaneous Improvements	1924	5,650 00	5,650 00	–
Rural Engineering building	1924	15,000 00	12,178 30	2,821 70
Market garden Field station	1924	25,000 00	1,995 64	23,004 36
	–	$386,150 00	$349,448 89	$36,701 11
Amount spent previous to Dec. 1, 1923	–	–	–	209,012 68
Amount expended during fiscal year	–	–	–	140,436 21
Unexpended balance Nov. 29, 1924	–	–	36,701 11	–
	–	$386,150 00	$386,150 00	$386,150 00

Inventory — Real Estate.

Land (Estimated Value).

Angus Land	$800 00
Allen Place	500 00
Baker Place	2,500 00
Bangs Place	2,350 00
Brooks Farm	11,000 00
Brown Land	500 00
Charmbury Place	450 00
Clark Place	4,500 00
College Farm	37,000 00
Cranberry Land	12,745 00
George Cutler Jr. Trustee	2,700 00
Dickinson Land	7,850 00
Harlow Farm and Orchard	3,284 63
Hawley and Brown Place	675 00
Kellogg Place	3,368 45
Loomis Place	415 00
Louisa Baker Place	5,000 00
Market Garden Field Station	21,000 00
Mount Toby demonstration forest	30,000 00
Newell Farm	2,800 00
Old Creamery Place	1,000 00
Owen Farm	5,000 00
Pelham Quarry	500 00
Tillson Farm	2,950 00
Westcott Place	2,250 00
	$161,138 08

College Buildings (Estimated Value, 1924).

	Inventory at Beginning of Year.	Per Cent deducted.	Value at Beginning of Year less Deterioration.	Repairs and Improvements during Year.	Total Value at Close of Fiscal Year.
Adams Hall	$125,809 90	2	$123,293 70	$498 94	$123,792 64
Apiary	2,827 13	2	2,770 59	85 60	2,856 19
Cashier's House	2,145 83	5	2,038 54	246 62	2,285 16
Chemistry Store House	49 55	2	48 56	–	48 56
Clark Hall	60,205 69	2	59,001 58	164 79	59,166 37
Cold Storage Laboratory	10,172 62	2	9,969 17	1 63	9,970 80
Dairy Barn and Storage	29,361 49	3	28,480 65	449 78	28,930 43
Draper Hall	71,971 67	3	69,812 52	3,618 98	73,431 50
Drill Hall and Gun Shed	9,223 52	5	8,762 34	193 55	8,955 89
Durfee Glass House, old	7,296 29	5	6,931 48	26 08	6,957 56
Durfee Glass House, new	10,247 16	5	9,734 80	56 09	9,790 89
Farm Blacksmith Shop	418 13	3	405 59	–	405 59
Farm Bungalow No. 1	2,477 64	3	2,403 31	41 49	2,444 80
Farm Bungalow No. 2	–	–	–	–	4,265 16
Farm Bungalow No. 3	–	–	–	–	4,207 93
Farm House No. 1	3,196 62	3	3,100 62	176 28	3,276 90
Farm Bull Pens and Fence	4,529 40	5	4,302 93	67 78	4,370 71
Fernald Hall	69,982 09	2	68,582 45	550 06	69,132 51
Flint Laboratory	69,580 58	2	68,188 97	2,856 82	71,045 79
French Hall	45,696 77	2	44,782 83	776 83	45,559 66
Goessmann Laboratory	–	–	–	–	288,299 00
Grinnell Arena	8,628 35	2	8,455 78	90 90	8,546 68
Ground Tool Shed	189 57	5	180 09	–	180 09
Harlow House	2,090 29	5	1,985 78	16 06	2,001 84
Horse Barn	4,627 08	3	4,488 27	22 25	4,510 52
Head of Division of Horticulture	2,761 34	5	2,623 27	462 88	3,086 15
Horticultural Barn	3,761 82	3	3,648 97	95 71	3,744 68
Horticultural Garage	1,533 48	3	1,487 48	56	1,488 04
Horticultural Tool Shed	4,294 06	3	4,165 24	983 48	5,148 72
Horticultural Open Shed	445 88	5	423 59	–	423 59
Horticultural Manufactures Shed	3,271 38	5	3,107 81	–	3,107 81
Hospital	15,426 88	2	15,118 34	683 30	15,801 64
Jewett House and Barn	3,156 03	5	2,998 23	239 33	3,237 56
Machinery Barn	3,342 20	3	3,241 93	–	3,241 93
Market Garden Field Station Farmhouse	–	–	–	–	6,000 00
Market Garden Field Station Ice House	–	–	–	–	100 00
Market Garden Field Station Large Cow Barn	–	–	–	–	9,000 00
Market Garden Field Station Small Stock Barn	–	–	–	–	2,000 00
Market Garden Field Station Small Shed	–	–	–	–	800 00
Mathematical Building	4,394 90	5	4,175 15	54 08	4,229 23
Memorial Hall	102,133 02	2	100,090 36	177 80	100,268 16
Microbiology Building	55,477 59	2	54,368 04	403 70	54,771 74
Military Storage	193 44	5	183 77	–	183 77
Mount Toby House and Barn	3,402 63	5	3,232 50	–	3,232 50
North Dormitory	27,553 35	2	27,002 28	890 02	27,892 30
Paige Laboratory and Stable	23,563 33	2	23,092 06	296 39	23,388 45
Physics Laboratory	4,634 80	5	4,403 06	48 65	4,451 71
Piggery	2,335 97	3	2,265 89	451 94	2,717 83
Poultry departments:					
No. 1, Demonstration Building	1,873 29	2	1,835 82	167 92	2,003 74
2, Oil House	72 09	2	70 65	65 87	136 52
3, Brooder, killing and fattening laboratory	2,268 80	2	2,223 42	7 88	2,231 30
4, Mechanics, storage building and incubator cellar	4,149 59	2	4,066 60	–	4,066 60
5, Laying House	1,750 28	2	1,715 27	–	1,715 27
6, Manure Shed	138 16	2	135 40	–	135 40
7, Small Henhouse	43 09	2	42 13	–	42 13
8, Breeding House	1,416 38	2	1,388 05	46 26	1,434 31
9, Experimental Breeding House	584 99	2	573 29	46 26	619 55
10, Duck House	89 28	2	87 49	–	87 49
11, Unit house for 200 hens	448 21	2	439 25	–	439 25
12, Unit house for 100 hens	361 66	2	354 43	46 27	400 70
Power Plant and Storage Building, including Coal Pocket	49,472 39	2	48,482 94	419 08	48,902 02

College Buildings, Etc. — Concluded.

	Inventory at Beginning of Year.	Per Cent deducted.	Value at Beginning of Year less Deterioration.	Repairs and Improvements during Year.	Total Value at Close of Fiscal Year.
President's House	$13,589 32	3	$13,181 64	$377 51	$13,559 15
Rural Engineering Building	15,043 63	2	14,742 76	18 16	14,760 92
Sheep Barn	1,308 78	3	1,269 52	254 16	1,523 68
South Dormitory	40,951 76	2	40,132 72	1,434 44	41,567 16
Stable for Cavalry Unit	17,756 81	3	17,424 11	922 12	18,346 23
Stockbridge Hall	162,115 79	2	158,873 47	753 49	159,626 96
Agronomy Greenhouse and storage	1,924 67	2	1,886 18	2,816 06	4,702 24
Stockbridge House	2,240 05	5	2,128 05	24 24	2,152 29
Stone Chapel	29,620 71	2	29,028 30	258 82	29,287 12
Turbine House	17,706 08	2	17,351 96	–	17,351 96
Vegetable Plant House	5,253 33	5	4,990 66	270 50	5,261 26
Waiting Station	503 11	2	493 05	46 40	539 45
Wilder Hall	32,511 68	2	31,861 45	157 35	32,018 80
Young Stock Barns	6,358 44	3	6,167 69	228 96	6,396 65
Totals	$1,211,961 84	–	$1,184,294 82	$23,090 22	$1,522,057 13

College Equipment (Estimated Value).

Administrative Division:	
Dean's Office	$1,318 45
President's Office	2,676 00
Registrar's Office	1,205 60
Treasurer's Office	5,095 00
Agricultural Division:	
Agronomy	8,351 97
Animal Husbandry	925 37
Dairy	25,972 10
Farm	22,968 99
Farm Live Stock	37,015 00
Farm Management	1,150 95
Freshman Agriculture	164 80
General Agriculture	2,248 77
Poultry	9,743 48
Rural Engineering	7,167 93
Rural Home Life	4,116 79
Dining Hall	29,389 87
Extension	15,153 93
General Science:	
Apiary	2,580 77
Botanical	25,799 76
Chemistry	29,792 63
Entomology	6,314 10
Mathematics	2,329 80
Microbiology	6,577 99
Physics	8,107 12
Veterinary	14,780 62
Zoölogy and Geology	17,348 70
Graduate School	127 18
Horticultural Division:	
Floriculture	13,069 17
Forestry	1,585 83
General Horticulture	8,013 98
Grounds	2,022 06
Horticultural Manufactures	6,029 10
Landscape Gardening	6,208 50
Market Garden Field Station	3,862 22
Mount Toby Reservation	744 36
Pomology	6,519 95
Vegetable Garden	3,679 05

Hospital	$1,003 25
Humanities Division:	
Economics and Sociology	189 71
Language and Literature	689 90
Library	139,651 07
Military	1,624 43
Operating and Maintenance:	
College Supply	986 61
Fire Apparatus	1,655 75
General Maintenance:	
Office	785 55
Carpentry and Masonry Supplies	4,593 15
Carpentry and Masonry Tools	4,518 89
Electrical Supplies	3,015 81
Electrical Tools	231 29
Electrical Commencement Supplies	619 75
Heating and Plumbing Supplies	9,956 71
Heating and Plumbing Tools	488 90
Painting Supplies	1,475 63
Painting Tools	223 18
Steam Main	54,349 10
Lighting Lines	11,801 11
Janitor's Supplies	1,067 56
Sewer Line	15,974 52
Water Mains	14,181 74
Power Plant:	
General Equipment	102,603 63
Tools	2,616 53
Supplies	406 46
Fuel	5,784 76
Physical Education	1,763 96
Rural Social Science:	
Agricultural Economics	1,987 54
Agricultural Education	1,586 41
Rural Sociology	267 52
Short Course	2,228 94
Text Books	2,100 22
Social Union Room	780 00
Women's Dormitory	16,201 05
Memorial Hall	15,733 24
Totals	$763,311 76

Experiment Station Buildings (Estimated Value).

	Inventory at Beginning of Year.	Per Cent.	Cost at Beginning of Year less Per Cent Deterioration.	Repairs and Improvements during Year.	Total Value at Close of Year.
Agricultural laboratory	$14,322 17	2	$14,035 73	$84 19	$14,119 92
Agricultural barn	4,230 41	3	4,103 50	790 38	4,893 88
Agricultural farmhouse	1,658 47	3	1,608 72	279 48	1,888 20
Agricultural glasshouse	327 17	5	310 81	776 28	1,087 09
Brooks House	2,930 99	5	2,784 44	111 31	2,895 75
Brooks barn and sheds	1,425 00	5	1,353 75	–	1,353 75
Brooks tobacco barn	–	–	–	–	3,000 00
Cranberry buildings	2,779 87	5	2.640 88	–	2,640 88
Entomological glasshouses	585 01	5	555 76	–	555 76
Plant and Animal Chemistry laboratory	27,196 64	2	26,652 71	196 04	26,848 75
Plant and Animal Chemistry Barns	5,346 28	3	5,185 89	748 77	5,934 66
Plant and Animal Chemistry Dairy	1,520 47	3	1,474 86	283 12	1,757 98
Six poultry houses	702 81	2	688 75	–	688 75
Tillson house	998 77	5	948 83	–	948 83
Tillson barn	882 11	5	838 00	205 60	1,043 60
Tillson Poultry houses (4) Nos. 2-3-4-5	2,954 04	2	2,894 96	–	2,894 96
Tillson Incubator cellar No. 1	720 59	2	706 18	–	706 18
Tillson Summer Sheds (3) No. 6	276 96	5	263 11	177 01	440 12
Tillson Pullet Brooder No. 7	1,091 26	5	1,036 70	85 22	1,121 92
Tillson Hen Brooder No. 8	1,174 46	5	1,115 74	52 73	1,168 47
Totals	$71,123 48	–	$69,199 32	$3,790 13	$75,989 45

Experiment Station Equipment.

	Estimated Value.
Apiary	$144 71
Agricultural Economics Department	379 83
Agronomy Department	165 41
Botanical Laboratory	8,313 41
Chemical Laboratory	31,835 78
Cranberry Station	6,636 82
Director's Office	4,989 45
Entomological Laboratory	24,603 46
Meteorological Laboratory	741 00
Microbiological Laboratory	3,609 70
Pomology	5,382 18
Poultry Department	5,977 93
Station Service	9,423 05
Treasurer's Office	982 53
Veterinary	2,076 59
Totals	$105,261 85

Summary.

Land	$161,138 08
College buildings	1,522,057 13
College equipment	763,311 76
Experiment Station buildings	75,989 45
Experiment Station equipment	105,261 85
Total	$2,627,758 27

	Acres.
College estate (area)	702.19
Cranberry Station, Wareham (area)	23.67
Market Garden Field Station, Waltham (area)	55.39
Mount Toby demonstration forest (area)	755.27
Rifle range	46.20
Pelham quarry	.50
Total acreage	1,583.22

STUDENTS' TRUST FUND ACCOUNT.

	Disbursements, Year ending Nov. 29, 1924.	Receipts Year ending Nov. 29, 1924.	Balance on Hand.	Balance brought forward Dec. 1, 1923.
Athletics	$20,550 17	$21,830 13	$878 26	—$401 70
Dining Hall	103,546 32	96,752 87	—9,911 07	—3,117 62
Keys	54 00	51 00	81 00	84 00
Student deposits	47,764 71	49,133 82	13,887 36	12,518 25
Social Union	2,164 92	2,421 67	340 32	83 57
Text Books	9,554 33	10,669 81	2,438 02	1,322 54
Athletic Field	–	–	169 70	169 70
Uniforms	5,940 72	5,602 19	4,532 51	4,871 04
Cow-Testing	16,572 15	16,427 03	2,069 52	2,214 64
Totals	$206,147 32	$202,888 52	$14,485 62	$17,744 42
Balance beginning fiscal year	–	17,744 42	–	–
Balance on hand November 29, 1924	14,485 62	–	–	–
Totals	$220,632 94	$220,632 94	–	–

CONDENSED OPERATING STATEMENT OF THE DINING HALL.

	Operating Charges.	Income.
1923.		
Dec. 1, Balance	$3,117 62	
1924.		
Nov. 29, Total Disbursements	103,546 32	–
Outstanding bills	838 56	–
Total collections	–	$96,752 87
Accounts outstanding	–	1,669 60
Inventory	–	9,580 29
Balance	500 26	–
Totals	$108,002 76	$108,002 76

ENDOWMENT FUND.[1]

	Principal.	Income.
United States grant (5 per cent)	$219,000 00	$7,300 00
Commonwealth grant ($3\frac{1}{2}$ per cent)	142,000 00	3,313 32
	–	$10,613 32

BURNHAM EMERGENCY FUND.

	Market Value Dec. 1, 1924.	Par Value.	Income.
Two bonds American Telephone and Telegraph Company 4s at $97	$1,940 00	$2,000 00	$80 00
Two bonds Power Corporation of N. Y. $6\frac{1}{2}$s at $100	2,000 00	2,000 00	130 00
One United States Liberty Bond $4\frac{1}{4}$s $101	505 00	500 00	21 25
One bond Ohio Service Company 6s $103	515 00	500 00	30 00
	$4,960 00	$5,000 00	$261 25
Disbursements for fiscal year ending November 29, 1924	–	–	31 94
	–	–	$229 31
Unexpended balance December 1, 1923	–	–	93 09
Cash on hand November 29, 1924	–	–	$322 40

[1] This fund is in the hands of the State Treasurer, and the Massachusetts Agricultural College receives two-thirds of the income from the same.

Library Fund.

	Market Value Dec. 1, 1924.	Par Value.	Income.
Five bonds New York Central & Hudson River Railroad Company 4s at $94	$4,700 00	$5,000 00	$200 00
Five bonds Lake Shore and Michigan Southern Railroad Company 4s at $98	4,900 00	5,000 00	200 00
Two shares New York Central & Hudson River Railroad Company Stock at $118	236 00	200 00	14 00
Amherst Savings Bank deposit	167 77	167 77	7 59
	$10,003 77	$10,367 77	$421 59
Sales of New York Central & Hudson River (stk) rights	–	–	5 38
	–	–	$426 97
Disbursements for fiscal year ending Nov. 29, 1924	–	–	426 97

Special Funds.

Endowed Labor Fund (the Gift of a Friend of the College).

Two bonds American Telephone and Telegraph Company 4s at $97	$1,940 00	$2,000 00	$80 00
Two bonds Lake Shore & Michigan Southern Railroad Company 4s, at $98	1,960 00	2,000 00	80 00
One bond New York Central R. R. Gold debenture 4s	940 00	1,000 00	40 00
One bond Ohio Service Company 6s	1,030 00	1,000 00	60 00
Amherst Savings Bank, deposit	143 39	143 39	6 49
One bond Indiana Hydro Electric Co. 6s	990 00	1,000 00	–
	$7,003 39	$7,143 39	$266 49
Unexpended balance Dec. 1, 1923	–	–	664 63
United States Liberty Bond	–	–	42 50
Earnings from exchange of bonds	–	–	8 60
Cash on hand Nov. 29, 1924	–	–	$982 22

Whiting Street Scholarship Fund.

One bond New York Central & Hudson R. R. Gold debenture	$940 00	$1,000 00	$40 00
Amherst Savings Bank, deposit	271 64	271 64	12 32
	$1,211 64	$1,271 64	$52 32
Unexpended balance Dec. 1, 1923	–	–	607 97
Cash on hand Nov. 29, 1924	–	–	$660 29

Hills Fund.

One United States Liberty Bond 4¼	$1,010 00	$1,000 00	$42 50
One bond American Telephone and Telegraph Company 4s	970 00	1,000 00	40 00
One bond New York Central & Hudson River Railroad debenture 4s	940 00	1,000 00	40 00
One bond New York Central Railroad debenture 4s	940 00	1,000 00	40 00
Three bonds Pacific Telephone & Telegraph Company 5s at $99	2,970 00	3,000 00	150 00
One Penn Public Service Corporation 6s	1,010 00	1,000 00	60 00
Boston & Albany Railroad stock 3 5/8 shares at $160	580 00	362 00	31 68
Amherst Savings Bank, deposit	72 75	72 75	3 28
Electric Securities Company bonds, 1 9/50 bonds at $98	1,156 40	1,180 00	59 00
Two bonds Great Western Light & Power Co. 6s at $101	2,020 00	2,000 00	120 00
One bond Potomac Edison Co. at 6½	1,020 00	1,000 00	–
	$12,689 15	$12,614 75	$586 46
Unexpended balance Dec. 1, 1923	–	–	2,339 48
One United States Liberty Bond	–	–	42 50
Earnings from exchange of bonds	–	–	8 44
	–	–	$2,976 88
Disbursements for fiscal year ending Nov. 29, 1924	–	–	358 00
Cash on hand Nov. 29, 1924	–	–	$2,618 88

Mary Robinson Fund.

Amherst Savings Bank deposit	$142 00	$142 00	$6 45
Boston & Albany Railroad stock 3/8 share at $160	60 00	38 00	3 32
Electric Securities Company bonds 41/50 bond at $98	803 60	820 00	41 00
	$1,005 60	$1,000 00	$50 77
Unexpended balance Dec. 1, 1923	–	–	190 38
Cash on hand Nov. 29, 1924	–	–	$241 15

Grinnell Prize Fund.

	Market Value Dec. 1, 1924.	Par Value.	Income.
Ten shares New York Central & Hudson River Railroad stock, at $118	$1,180 00	$1,000 00	$70 00
Unexpended balance Dec. 1, 1923	–	–	255 74
Sales of New York Central & Hudson River rights	–	–	26 90
	$1,180 00	$1,000 00	$352 64
Disbursements for Prizes	–	–	50 00
Cash on hand Nov. 29, 1924	–	–	$302 64

Gassett Scholarship.

One bond New York Central & Hudson River Railroad debenture 4s	$940 00	$1,000 00	$40 00
Amherst Savings Bank deposit	11 64	11 64	48
	$951 64	$1,011 64	$40 48
Unexpended balance Dec. 1, 1923	–	–	466 26
Cash on hand Nov. 29, 1924	–	–	$506 74

Massachusetts Agricultural College (Investment).

One share New York Central & Hudson River Railroad stock	$118 00	$100 00	$7 00
Unexpended balance Dec. 1, 1923	–	–	116 45
Sales of New York Central & Hudson River rights	–	–	2 69
Cash on hand Nov. 29, 1924	$118 00	–	$126 14

Danforth Keyes Bangs Fund.

Two bonds Pacific Telephone and Telegraph Company 5s at $99	$1,980 00	$2,000 00	$100 00
Two bonds Union Electric Light and Power Company 5s at $98	1,960 00	2,000 00	100 00
Two bonds American Telephone and Telegraph Company 4s at $97	1,940 00	2,000 00	80 00
One bond Oklahoma Gas & Electric Co. 6s	980 00	1,000 00	–
Interest from Student Loans	–	–	118 17
	$6,860 00	$7,000 00	$398 17
Unexpended balance Dec. 1, 1923	–	–	1,372 56
One United States Liberty Bond	–	–	42 50
Earnings from exchange of bonds	–	–	28 61
	–	–	$1,841 84
Total loans made to students during fiscal year $2,492	–	–	–
Cash received on account of student loans $2,869.50	–	–	–
Excess of cash received over loans made	–	–	377 50
Cash on hand Nov. 29, 1924	–	–	$2,219 34

John C. Cutter Fund.

One bond Pacific Telephone and Telegraph Company 5s	$990 00	$1,000 00	$50 00
Unexpended balance Dec. 1, 1923	–	–	71 83
	$990 00	$1,000 00	$121 83
Disbursements for fiscal year ending Nov. 30, 1924	–	–	30 49
Cash on hand Nov. 29, 1924	–	–	$91 34

William R. Sessions Fund.

One bond New York Central Railroad debenture 6s	$565 00	$500 00	$30 00
Three United States Liberty Bonds, two at $1,000 and one at $500, 4¼s at $101	2,525 00	2,500 00	106 20
One bond Adirondack Light & Power Company 6s	1,010 00	1,000 00	60 00
One bond Southern Illinois Light & Power Company 6s	1,020 00	1,000 00	60 00
	$5,120 00	$5,000 00	$256 25
Unexpended balance Dec. 1, 1923	–	–	69 16
	–	–	$325 41
Disbursements for fiscal year ending Nov. 29, 1924	–	–	166 57
Cash on hand Nov. 29, 1924	–	–	$158 84

Alvord Dairy Scholarship Fund.

	Market Value Dec. 1, 1924.	Par Value.	Income.
One United States Liberty Bond 4¼	$1,010 00	$1,000 00	$42 50
One bond Southern Illinois Light & Power Co. 7s	1,010 00	1,000 00	70 00
Two bonds Great Western Power Co. 6s at $101	2,020 00	2,000 00	120 00
	$4,040 00	$4,000 00	$232 50
Unexpended balance Dec. 1, 1923	–	–	1,242 61
	–	–	$1,475 11
Disbursements for fiscal year ending Nov. 29, 1924	–	–	380 00
Cash on hand Nov. 29, 1924	–	–	$1,095 11

J. D. W. French Fund.

Two bonds Southern Illinois Light & Power Co. 6s at $102	$2,040 00	$2,000 00	$120 00
Two bonds Great Western Light & Power Co. 6s at $101	2,020 00	2,000 00	120 00
Four bonds Penn Public Service Corporation, two 6½s at $102, two 6s at $101	4,060 00	4,000 00	250 00
Two bonds Ohio Service Company 6s at $103	2,060 00	2,000 00	120 00
	$10,180 00	$10,000 00	$610 00
Unexpended balance Dec. 1, 1923	–	–	746 39
	–	–	$1,356 39
Disbursements for fiscal year ending Nov. 29, 1924	–	–	430 27
Cash on hand Nov. 29, 1924	–	–	$926 12

Students' Loan Fund of the Massachusetts Agricultural Club.

First National Bank	$500 00	$500 00	–
Total loans to students	–	400 00	–
	–	–	$100 00
Interest from student loans	–	–	3 86
Cash on hand Nov. 29, 1924	–	–	$103 86

F. H. Crane Fund.

Five bonds Ohio Service Company 6s at $103		$5,150 00	$5,000 00	$300 00
Two bonds Power Corporation of New York 6½s at $100		2,000 00	2,000 00	130 00
Four bonds Potomac Edison Company 6½s at $102		4,080 00	4,000 00	260 00
Four bonds Northern New York Utilities 6s at $101		4,040 00	4,000 00	240 00
Five bonds Penn Public Service Corporation 6½s at $102		5,100 00	5,000 00	162 50
Five bonds Illinois Power and Light Corporation 6s at $101		5,050 00	5,000 00	150 00
Amherst Savings Bank		250 00	250 00	93
		$25,670 00	$25,250 00	$1,243 43
Interest on bonds	$423 70	–	–	–
Scholarships to students	200 00	–	–	–
Printing	4 16	–	–	627 86
Cash on hand Nov. 29, 1924		–	–	$615 57

Summary of Balance on Hand of the Income from Funds held in Trust by the M. A. C.

Burnham Emergency Fund	$322 40
Endowed Labor Fund	982 22
Whiting Street Scholarship Fund	660 29
Hills Fund	2,618 88
Mary Robinson Fund	241 15
Grinnell Prize Fund	302 64
Gassett Scholarship	506 74
Massachusetts Agricultural College Investment	126 14
Danforth Keyes Bangs Fund	2,219 34
John C. Cutter Fund	91 34
Alvord Dairy Scholarship Fund	1,095 11
J. D. W. French Fund	926 12
Massachusetts Agricultural Club Fund	103 86
William R. Sessions Fund	158 84
F. H. Crane Fund	615 57
	$10,970 64

I hereby certify that I have this day examined the Massachusetts Agricultural College Account, as reported by the Treasurer, Fred C. Kenney, for the year ending November 29, 1924. All bonds and investments are as represented in the Treasurer's report. All disbursements are properly vouched for, and all cash balances are found to be correct.

CHARLES A. GLEASON, *Auditor.*

JANUARY 5, 1925.

HISTORY OF SPECIAL FUNDS.

Burnham Emergency Fund. — A bequest of $5,000 from T. O. H. P. Burnham of Boston made without any conditions. The Trustees of the College have used this fund in any cases of emergency where funds were not available. At present the fund is intact and the income only has been used for such emergency matters as the Trustees have authorized. The fund now shows an investment of $5,000.00.

Library Fund. — The library of the college at the present time contains 73,380 volumes. The income from the fund raised by the alumni and others is devoted to its increase, and additions are made from time to time as the needs of the different departments require. Dec. 27, 1883, William Knowlton gave $2,000; Jan. 1, 1894, Charles L. Flint gave $1,000; in 1887, Elizur Smith of Lee, Mass., gave $1,315. These were the largest bequests and now amount to $10,000.00.

Endowed Labor Fund. — Gift of a friend of the college in 1901, income of which is to be used for the assistance of needy and deserving students, $5,000.00.

Whiting Street Scholarship Fund. — Gift of Whiting Street of Northampton, for no special purpose, but to be invested and the income used. This fund is now used exclusively for scholarship, $1,000.00.

Hills Fund. — Gift of Leonard M. and Henry F. Hills of Amherst, Mass., in 1867, to establish and maintain a botanic garden, $10,000.00.

Mary Robinson Fund. — Gift of Miss Mary Robinson of Medfield, in 1874, for scholarship, $1,000.00.

Grinnell Prize Fund. — Gift of Hon. Wm. Claflin, to be known as the Grinnell agricultural prize, to be given to the two members of the graduating class who may pass the best oral and written examination in theory and practice of agriculture, given in honor of George B. Grinnell of New York, $1,000.00.

Gassett Scholarship Fund. — Gift of Henry Gassett of Boston, the income to be used for scholarship, $1,000.00.

Massachusetts Agricultural College Investment Fund. — Investment made by vote of trustees in 1893 to purchase one share of New York Central & Hudson River Railroad stock. The income from this fund has been allowed to accumulate, $100.00.

Danforth Keyes Bangs Fund. — Gift of Louisa A. Baker of Amherst, Mass., April 14, 1909, the income thereof to be used annually in aiding poor, industrious, and deserving students to obtain an education in said college, $6,000.00.

John C. Cutter Fund. — Gift of Dr. John C. Cutter of Worcester, Mass., an alumnus of the college, who died in August, 1909, to be invested by the trustees, and the income to be annually used for the purchase of books on hygiene, $1,000.00.

Alvord Dairy Scholarship Fund. — Gift of Henry E. Alvord, who was the first instructor in military tactics, 1869–71, and a professor of agriculture, 1885–87, at this institution. The income of this fund is to be applied to the support of any worthy student of said college, graduate or postgraduate, who may be making a specialty of the study of dairy husbandry (broadly considered) with the intention of becoming an investigator, teacher or special practitioner in connection with the dairy industry, provided that no benefits arising from such fund shall at any time be applied to any person who then uses tobacco in any form, or fermented or spirituous beverages, or is known to have done so within one year next preceding, $4,000.00.

William R. Sessions Fund. — In accordance with the request of my deceased wife, Clara Markham Sessions, made in her last will, I bequeath to the trustees of the Massachusetts Agricultural College, Amherst, Mass., the sum of $5,000, it being the amount received by me from the estate of the said Clara Markham

Sessions. The said $5,000 to be kept by the said trustees a perpetual fund, the income from which shall be for the use of the Massachusetts Agricultural College; and according to the further request of my deceased wife, made in her last will, this is to be known as the William R. Sessions fund, and is to be a memorial of William R. Sessions; and it is my special request that the said trustees shall make record of the fact that this fund came from the estate of my deceased wife Clara Markham Sessions, in accordance with her request made in her last will, $5,000.00.

J. D. W. French Fund. — Gift of the Bay State Agricultural Society of Boston, Massachusetts. This fund to be known as the J. D. W. French Fund, and the Trustees of the Massachusetts Agricultural College are to use the income of this fund where it will do the greatest good, in the interest of Dairying and its allies, also in Forestry, as scholarships, loans, or prizes; especially, however, to help pay the expenses of the judging teams to the National Dairy Show and to the National Livestock Show, $10,000.00.

Frederick G. Crane Fund. — Gift of Frederick G. Crane of Dalton, Massachusetts. The income of this fund is to be expended by the Trustees of the Massachusetts Agricultural College in aid of worthy undergraduate students of limited financial resources at the college, preference being given to residents of Berkshire County; such payments are to be known as the Frederick G. Crane Scholarships, $25,000.00.

Massachusetts Agricultural College Fund. — The Massachusetts Agricultural Club gave $500 to be used as a scholarship fund to the Massachusetts Agricultural College to help out deserving students there, who intended seriously to go into agriculture, interest on loans not to be charged until after graduation, $500.00.

Total of special funds, $85,600.00.

FRED C. KENNEY,
Treasurer.

PUBLIC DOCUMENT No. 31

MASSACHUSETTS AGRICULTURAL COLLEGE

CATALOGUE, 1924-1925

PUBLIC DOCUMENT No. 31

THE M. A. C. BULLETIN
AMHERST, MASSACHUSETTS

VOLUME XVII JANUARY, 1925 NUMBER 1

PUBLISHED EIGHT TIMES A YEAR BY THE MASSACHUSETTS AGRICULTURAL COLLEGE: JAN., FEB., MARCH, MAY, JUNE, SEPT., OCT., NOV. ENTERED AT THE POST OFFICE, AMHERST, MASS., AS SECOND CLASS MATTER

THE SIXTY-SECOND ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE

PART II.—CATALOGUE OF THE COLLEGE FOR 1924-1925

Publication of this Document approved by the Commission on Administration and Finance

The Commonwealth of Massachusetts

MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, November 29, 1924.

To the Commissioner of Education.

SIR: — On behalf of the trustees of the Massachusetts Agricultural College I have the honor to transmit herewith Part II of the sixty-second annual report of the trustees for the fiscal year ended November 29, 1924, this being the catalogue of the college.

Respectfully yours,

EDWARD M. LEWIS,
Acting President.

CONTENTS.

Without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and mechanic arts in such manner as the legislatures of the states may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life. — *Act of Congress, July 2, 1862.*

This issue of the catalogue represents the status of the college for the current college year, with provisional announcement of courses of study and other matters for the year to follow. When deemed necessary, additional announcements are made in a supplementary bulletin, published in the spring.

The college reserves, for itself and its departments, the right to withdraw or change the announcements made in its catalogue.

Calendar.

1924-1925.

Regular and Two-Year Courses.

1924.

September 10–13, Wednesday–Saturday . .	Entrance Examinations
September 15, Monday, 1.30 P.M. . . .	Fall term begins for Freshmen
September 17, Wednesday, 1.30 P.M. . .	Fall term begins for all except Freshmen; assembly
October 13, Monday	Holiday, observance of Columbus Day
November 26–December 1, Wednesday, 12 M.– Monday, 7.30 A.M.	Thanksgiving Recess
December 20, Saturday, 12 M.	Fall term ends
December 30, Tuesday, 7.30 A.M. . . .	Winter term begins; chapel

1925.

January 1, Thursday	Holiday, New Year's Day
February 23, Monday	Holiday, observance of Washington's Birthday
March 21, Saturday, 12 M.	Winter term ends
March 30, Monday, 1 P.M.	Spring term begins
April 20, Monday	Holiday, observance of Patriot's Day
May 30, Saturday	Holiday, Memorial Day
June 13–15, Saturday–Monday	Commencement
June 18–20, Thursday–Saturday . . .	Entrance examinations
September 9–12, Wednesday–Saturday . .	Entrance examinations
September 14, Monday	Fall term begins for Freshmen
September 16, Wednesday	Fall term begins for all except Freshmen; assembly

MASSACHUSETTS AGRICULTURAL COLLEGE.

HISTORY. — The Massachusetts Agricultural College was organized under the national land grant act of 1862. This legislation is also known as the Morrill act, the original bill having been framed by Justin Smith Morrill, Senator from Vermont, and its final enactment secured under his leadership. It provided that public lands be assigned to the several States and territories, the funds from the sale of which were to be used to establish and maintain colleges of agriculture and mechanic arts. The Massachusetts Agricultural College was among the first of these institutions established. When this act was passed the Massachusetts Institute of Technology was already organized, and the State of Massachusetts decided that the instruction in the mechanic arts should be at the institute, and that the new institution should confine its work to agriculture. On this account the Massachusetts Agricultural College has the unique distinction of being the only separate agricultural college in the country.

In 1863 the State of Massachusetts accepted the provisions of the Morrill act and incorporated the Agricultural College. The location at Amherst was selected only after long and careful study by the original Board of Trustees. The college was formally opened to students on the 2d of October, 1867, with a faculty of four teachers and with four wooden buildings.

The Massachusetts Legislature has granted money for the erection of practically all of the buildings now on the grounds. In view of the fact that the annual income from the original endowment has been only a few thousand dollars, it has been necessary for the State to assume large responsibility for the current expenses of the institution.

ORGANIZATION. — The college is a State institution, serving in the Department of Education and as such is subject to the laws governing and the rules applying to all State departments and institutions. The work of the college is directed by a board of eighteen trustees. Four of these are ex-officio members, — the Governor of the State, the Commissioner of Education, the Commissioner of Agriculture and the President of the college. The other fourteen members are appointed by the Governor, two each year, for terms of seven years. The immediate control of the institution is vested in the President of the college. The administrative officers, having supervision of the various departments of activity, are directly responsible to the President.

In carrying out its purpose the college has organized three distinct yet correlated types of work, — namely, research, resident instruction and extension service.

RESEARCH. — In 1882 Massachusetts provided for the establishment of an agricultural experiment station. This station, though on the college grounds and supported by the State, was without organic connection with the college. Under an act of Congress, passed in 1887, an agricultural experiment station was established and supported as a department of the college. For a time, therefore, Massachusetts had two experiment stations at the college. In 1895 these were combined, and the station reorganized as a department of the college. It is now supported by funds from both the State and the Federal government. In 1906 the Federal government largely increased its support on condition that the money thus provided should be used only for research. The station now receives about four-fifths of its support from the State.

The station is under the direct supervision of the Board of Trustees; the chief officer is the director, who is responsible to the President. It is organized into a

number of departments, all co-operating toward the betterment of agriculture. In most cases the heads of these departments are heads of corresponding departments in the college.

Resident Instruction. — The college offers an education without tuition fee to any student who is a resident of Massachusetts and who meets the requirements for admission. Women are admitted on the same basis as are men. Students who are not residents of Massachusetts are required to pay a tuition fee. The chief aim of the institution, through its resident instruction, is to prepare men and women for the agricultural vocations. The term "agricultural vocations" is here used in its broadest sense. Courses are offered which give efficient training in various agricultural pursuits, such as general farming, dairying, management of estates, poultry husbandry, fruit growing, market gardening, floriculture, landscape gardening and forestry. Students are also trained for investigation in many sciences underlying the great agricultural industry, for teaching in agricultural colleges and high schools, and for scientific work in chemistry, entomology, botany and microbiology. Comprehensive courses in home making are now available for women.

Though training for the agricultural vocations is thus the chief concern of the college, students should find the course one that trains them admirably for pursuits in which the sciences are an essential preparation. The course of study aims also to combine an adequate general education with specialized technical and practical training.

Four-year Courses. — Twenty-nine teaching departments offer instruction in agriculture, horticulture, sciences, the humanities, rural social science and home making. A system of major courses permits the student to elect major work in one of sixteen departments, and to specialize in it and allied subjects for a period of two years. The degree of bachelor of science is granted on the satisfactory completion of the four years' work of collegiate grade.

Short Courses. — In order to extend the advantages of the institution to those men and women who cannot or do not care to pursue the four-year course, various short courses are offered. Chief among these are a two-year course in practical agriculture, a summer school of agriculture and country life, and a winter school of agriculture.

Graduate School. — The graduate school is organized to provide the necessary training for scientific leadership in agriculture and allied sciences. The degrees of master of agriculture, master of landscape architecture, master of science, doctor of agriculture and doctor of philosophy may be earned upon the completion of satisfactory study, research and thesis.

The Extension Service. — The Extension Service is the organized educational agency of the college which serves the people of the State other than resident students. Its function is to make available to Massachusetts citizens useful and practical information in agriculture and home economics which is developed by the experiment station or the United States Department of Agriculture, and which is taught by the college to resident students. It is the recognized agency of the United States Department of Agriculture for teaching those who cannot attend college, and is a cooperative effort by the Department of Agriculture, the Massachusetts Agricultural College, and the County Extension Services.

The Extension Service uses many methods of work, among which are the following:

Demonstrations.
Publications.
Correspondence Courses.
Lectures.
Exhibits.
Extension Schools.
Leader-training Groups.
Boys' and Girls' Clubs in Agriculture and Home Economics.
Agricultural News Letters.

Literature descriptive of these various services will be mailed on request. Information may also be secured from the county agricultural agents at the following addresses:

Berkshire County Extension Service, Howard Block, Pittsfield, Mass.
Bristol County Agricultural School, Segreganset, Mass.
Cape Cod Extension Service, Hyannis, Mass.
Essex County Agricultural School, Hathorne, Mass.
Franklin County Extension Service, Sheldon Block, Greenfield, Mass.
Hampden County Improvement League, 244 Main St., Springfield, Mass.
Hampshire County Extension Service, 59 Main St., Northampton, Mass.
Middlesex County Extension Service, 12 Moody St., Waltham, Mass.
Norfolk County Agricultural School, Walpole, Mass.
Plymouth County Extension Service, 106 Main St., Brockton, Mass.
Worcester County Extension Service, 11 Foster St., Worcester, Mass.

Location and Equipment. — The Agricultural College is located in the town of Amherst. The grounds comprise approximately 700 acres, lying about a mile north of the village center. The college has also a demonstration forest of 755 acres, located 6 miles north of the campus. The equipment of the college, both in buildings and facilities for instruction, is excellent. Amherst is 97 miles from Boston, and may be reached by the Central Massachusetts division of the Boston & Maine Railroad, or by the Central Vermont Railroad. Electric car lines connect Amherst with Northampton, Holyoke and Springfield.

Military Drill. — By Federal law military drill is required of all regular students attending the Massachusetts Agricultural College.

THE TRUSTEES.

Organization of 1924.

MEMBERS OF THE BOARD.

	TERM EXPIRES
CHARLES H. PRESTON of Danvers	1925
CARLTON D. RICHARDSON of West Brookfield	1925
DAVIS R. DEWEY of Cambridge	1926
JOHN F. GANNON of Pittsfield	1926
ARTHUR G. POLLARD of Lowell	1927
GEORGE H. ELLIS of West Newton	1927
ELMER D. HOWE of Marlborough[1]	1928
JOHN CHANDLER of Sterling Junction	1928
ATHERTON CLARK of Newton	1928
NATHANIEL I. BOWDITCH of Framingham	1929
WILLIAM WHEELER of Concord	1929
CHARLES A. GLEASON of North Brookfield	1930
JAMES F. BACON of Boston	1930
FRANK GERRETT of Greenfield	1931
HAROLD L. FROST of Arlington	1931

MEMBERS EX-OFFICIO.

His Excellency Governor CHANNING H. COX, *President of the Board of Trustees.*
KENYON L. BUTTERFIELD,[2] *President of the College.*
EDWARD M. LEWIS, *Acting President of the College.*
PAYSON SMITH, *State Commissioner of Education.*
ARTHUR W. GILBERT, *State Commissioner of Agriculture.*

OFFICERS OF THE TRUSTEES.

His Excellency Governor CHANNING H. COX of Boston, *President.*
CHARLES A. GLEASON of North Brookfield, *Vice-President.*
RALPH J. WATTS of Amherst, *Secretary.*
FRED C. KENNEY of Amherst, *Treasurer.*
CHARLES A. GLEASON of North Brookfield, *Auditor.*

STANDING COMMITTEES OF THE TRUSTEES.[3]

Committee on Finance.

CHARLES A. GLEASON, *Chairman.*
GEORGE H. ELLIS.
NATHANIEL I. BOWDITCH.
ARTHUR G. POLLARD.
CARLTON D. RICHARDSON.
ATHERTON CLARK.

Committee on Course of Study and Faculty.

WILLIAM WHEELER, *Chairman.*
ELMER D. HOWE.[1]
JAMES F. BACON.
PAYSON SMITH.
DAVIS R. DEWEY.
JOHN F. GANNON.
ARTHUR W. GILBERT.

[1] Died June 17, 1924; succeeded by John Chandler, appointed September 3, 1924.
[2] Resigned August 31, 1924; succeeded by Edward M. Lewis, Acting President.
[3] The President of the College is ex-officio member of each committee.

Committee on Farm.

Nathaniel I. Bowditch, *Chairman.*
Frank Gerrett.
George H. Ellis.
Arthur W. Gilbert.
Carlton D. Richardson.

Committee on Horticulture.

Harold L. Frost, *Chairman.*
Charles A. Gleason.
Elmer D. Howe.[1]
Atherton Clark.
Charles H. Preston.

Committee on Experiment Department.

Charles H. Preston, *Chairman.*
Arthur W. Gilbert.
Arthur G. Pollard.
Harold L. Frost.
Carlton D. Richardson.

Committee on Buildings and Arrangement of Grounds.

George H. Ellis, *Chairman.*
Frank Gerrett.
William Wheeler.
James F. Bacon.
Charles H. Preston.
Atherton Clark.

Committee on Extension Service.

Elmer D. Howe,[1] *Chairman.*
George H. Ellis.
Harold L. Frost.
Davis R. Dewey.
Nathaniel I. Bowditch.
John F. Gannon.
Arthur W. Gilbert.

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[1] Died June 17, 1924; succeeded by John Chandler, appointed September 3, 1924.

Officers of the Institution.

As of Nov. 1, 1924.

Officers of General Administration.

Edward M. Lewis, A.M. . . . . President's House.
Dean and Acting President of the College.
Henry S. Green, A.B., LL.D.[1] . . . . Mount Pleasant.
Librarian of the College.
Sidney B. Haskell, B.Sc. . . . . 2 Mount Pleasant.
Director of the Experiment Station.
Fred C. Kenney . . . . Mount Pleasant.
Treasurer of the College.
William L. Machmer, A.M. . . . . 25 Amity Street.
Acting Registrar of the College.
Charles E. Marshall, Ph.D. . . . . 44 Sunset Avenue.
Director of the Graduate School.
Richard A. Mellen, B.Sc. . . . . 25 Fearing Street.
Field Agent.
Roland H. Verbeck, B.Sc. . . . . 99 Main Street.
Director of Short Courses.
Ralph J. Watts, B.Sc. . . . . 101 Butterfield Terrace.
Secretary of the College.
John D. Willard, B.A. . . . . 31 Lincoln Avenue.
Director of the Extension Service.
Basil B. Wood, A.B. . . . . The Davenport.
Librarian of the College.

The Faculty of Instruction.

Edward M. Lewis, A.M. . . . . President's House.
Dean and Acting President of the College, Professor of Languages and Literature, Head of Department and Head of Division of Humanities.
Max F. Abell, Ph.D. . . . . North Amherst.
Assistant Professor of Farm Management.
George W. Alderman, B.A. . . . . North Pleasant Street.
Instructor in Physics.
Charles P. Alexander, Ph.D. . . . . 120 Pleasant Street.
Assistant Professor of Entomology.
Edgar L. Ashley, A.M. . . . . Amherst House.
Professor of German.
Lorin E. Ball, B.Sc. . . . . 3 Allen Street.
Instructor in Physical Education.
Luther Banta, B.Sc. . . . . Sunset Avenue.
Assistant Professor of Poultry Husbandry.
Mary A. Bartley . . . . 50 Pleasant Street.
Instructor in Home Economics.
Arthur B. Beaumont, Ph.D. . . . . 51 Amity Street.
Professor of Agronomy and Head of Department.

[1] Retired Nov. 12, 1924.

Edward L. Bike, B.Sc. . . . . Sigma Phi Epsilon House.
Instructor in Physical Education.
Thomas Brady, Jr., Captain, Cavalry, U. S. A. . . . . Amherst House.
Assistant Professor of Military Science and Tactics.
Alexander E. Cance, Ph.D. . . . . 9 Fearing Street.
Professor of Agricultural Economics and Head of Department.
Morton H. Cassidy, B.Sc. . . . . The Apiary.
Assistant Professor of Beekeeping.
Joseph S. Chamberlain, Ph.D. . . . . Mount Pleasant.
Professor of Organic and Agricultural Chemistry.
Walter W. Chenoweth, M.Sc. . . . . North Amherst.
Professor of Horticultural Manufactures and Head of Department.
Orton L. Clark, B.Sc. . . . . 12 College Street.
Assistant Professor of Botany.
G. Chester Crampton, Ph.D. . . . . Fernald Hall.
Professor of Insect Morphology.
William H. Davis, Ph.D. . . . . 12 Nutting Avenue.
Assistant Professor of Botany.
Llewellyn L. Derby . . . . Amherst House.
Instructor in Physical Education.
Lawrence S. Dickinson, B.Sc. . . . . 2 Farview Way.
Assistant Professor of Horticulture.
Brooks D. Drain, B.Sc. . . . . 50 Pleasant Street.
Assistant Professor of Pomology.
Henry T. Fernald, Ph.D. . . . . 44 Amity Street.
Professor of Entomology, Head of Department, Chairman of Division of Science.
James A. Foord, M.Sc.Agr. . . . . 54 Lincoln Avenue.
Professor of Farm Management and Head of Department, Acting Head, Division of Agriculture.
Arthur P. French, M.Sc. . . . . 9 Phillips Street.
Instructor in Pomology.
Prentiss French, A.B., M.L.A. . . . . 5 Fearing Street.
Assistant Professor of Landscape Gardening.
George E. Gage, Ph.D. . . . . The Davenport.
Professor of Animal Pathology and Head of Department of Veterinary Science and Aminal Pathology.
Mary E. M. Garvey, B.Sc. . . . . 29 South Prospect Street.
Instructor in Microbiology.
Guy V. Glatfelter, M.Sc. . . . . 10 Kendrick Place.
Assistant Professor of Animal Husbandry.
Harry N. Glick, Ph.D. . . . . 27 Fearing Street.
Professor of Agricultural Education.
Helena T. Goessmann, M.Ph. . . . . 35 South Pleasant Street.
Instructor in English.
Clarence E. Gordon, Ph.D. . . . . 38 Lincoln Avenue.
Professor of Zoölogy and Geology, and Head of Department.
Harold M. Gore, B.Sc. . . . . Plainville Road.
Assistant Professor of Physical Education.
John C. Graham, B.Sc.Agr. . . . . 68 Lincoln Avenue.
Professor of Poultry Husbandry and Head of Department.
Laurence R. Grose, A.B., M.F. . . . . 32 Amity Street.
Professor of Forestry and Head of Department.
Christian I. Gunness, B.Sc. . . . . 105 Butterfield Terrace.
Professor of Rural Engineering and Head of Department.
Raymond Halliday, B.A. . . . . The Davenport.
Instructor in French.
Margaret Hamlin, B.A. . . . . 12 North East Street.
Agricultural Counsellor for Women.

Arthur K. Harrison . . . . 8 Allen Street.
Assistant Professor of Landscape Gardening.
Curry S. Hicks, B.Pd. . . . . The Davenport.
Professor of Physical Education and Hygiene, and Head of Department.
Mrs. Curry S. Hicks [1] . . . . The Davenport.
Instructor in Physical Education.
Dwight Hughes, Jr., Captain, Cavalry, U. S. A. . . . . . The Davenport.
Assistant Professor of Military Science and Tactics.
Belding F. Jackson, B.Sc. . . . . Belchertown.
Instructor in English.
Willard P. Jones, B.Sc. . . . . East Experiment Station.
Instructor in Agronomy.
Henry F. Judkins, B.Sc. . . . . 103 Butterfield Terrace.
Professor of Dairying and Head of Department.
Arthur N. Julian, A.B. . . . . 4 Farview Way.
Assistant Professor of German.
Helen Knowlton, A.M. . . . . 50 Pleasant Street.
Assistant Professor of Home Economics.
Herman Kobbe, Major, Cavalry, U. S. A. . . . . 35 South Pleasant Street.
Professor of Military Science and Tactics, and Head of Department.
Marshall O. Lanphear, B.Sc. . . . . 4 Nutting Avenue.
Assistant Professor of Agronomy.
John B. Lentz, A.B., V.M.D. . . . . 3 Dana Street.
Assistant Professor of Veterinary Science and College Veterinarian.
Joseph B. Lindsey, Ph.D. . . . . 47 Lincoln Avenue.
Goessmann Professor of Agricultural Chemistry and Head of Department.
William L. Machmer, A.M. . . . . 25 Amity Street.
Professor of Mathematics, Assistant Dean and Acting Registrar.
Alexander A. Mackimmie, A.M. . . . . North Amherst.
Professor of French.
Charles E. Marshall, Ph.D. . . . . 44 Sunset Avenue.
Professor of Microbiology and Head of Department.
Frederick A. McLaughlin, B.Sc. . . . . 4 Nutting Avenue.
Assistant Professor of Botany.
Charles A. Michels, M.Sc. . . . . 70 Lincoln Avenue.
Assistant Professor of Agronomy.
Frank C. Moore, A.B. . . . . 10 Allen Street.
Assistant Professor of Mathematics.
Richard T. Muller, M.Sc. . . . . 45 East Pleasant Street.
Assistant Professor of Floriculture.
John B. Nelson, Ph.D. . . . . 53 Lincoln Avenue.
Instructor in Microbiology.
John B. Newlon . . . . North Amherst.
Instructor in Rural Engineering.
A. Vincent Osmun, M.Sc. . . . . 16 Northampton Road.
Professor of Botany and Head of Department.
John E. Ostrander, A.M., C.E. . . . . 33 North Prospect Street.
Professor of Mathematics and Head of Department.
Charles H. Patterson, A.M. . . . . 26 Lincoln Avenue.
Professor of English.
John W. Patton, M.Sc., D.V.M. [2] . . . . 21 Pleasant Street.
Assistant Professor of Poultry Husbandry.
Harlow L. Pendleton, B.Sc. . . . . Fearing Street.
Instructor in Dairying.
Charles A. Peters, Ph.D. . . . . Sunset Place.
Professor of Inorganic and Soil Chemistry.
Arthur W. Phillips, A.M. . . . . 16 North Prospect Street.
Instructor in Chemistry.

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[1] Temporary. [2] Temporary, one year.

Wayland R. Porter, B.Sc. . . . . Belchertown Road
Instructor in Mathematics.
Walter E. Prince, A.M. . . . . 27 Amity Street
Assistant Professor of English.
Marion C. Pulley, B.Sc. . . . . 68 Lincoln Avenue
Instructor in Poultry Husbandry.
George F. Pushee . . . . North Amherst
Instructor in Rural Engineering.
George J. Raleigh, B.Sc. . . . . 7 East Pleasant Street
. Instructor in Pomology.
Frank Prentice Rand, A.M. . . . . 3 Mount Pleasant
Assistant Professor of English.
Victor A. Rice, M.Agr. . . . . 10 Woodside Avenue
Assistant Professor of Animal Husbandry.
Gordon C. Ring, A.M. . . . . 42 Lincoln Avenue
Instructor in Zoology.
William F. Robertson, B.Sc. . . . . 33 East Pleasant Street.
Instructor in Horticultural Manufactures.
Roland W. Rogers, B.Sc., M.L.A. . . . . . 32 North Prospect Street.
Assistant Professor of Horticulture.
William C. Sanctuary, B.Sc.[1] . . . . 23 Woodside Avenue.
Professor of Poultry Husbandry.
Donald W. Sawtelle, M.Sc. . . . . 5 Allen Street.
Assistant Professor of Agricultural Economics.
Fred C. Sears, M.Sc. . . . . Mount Pleasant.
Professor of Pomology and Head of Department.
Paul Serex, Jr., Ph.D. . . . . Lincoln Avenue.
Assistant Professor of Chemistry.
Newell L. Sims, Ph.D.[1] . . . . 16 North Prospect Street.
Professor of Rural Sociology.
Edna L. Skinner, B.Sc. . . . . 50 Lincoln Avenue.
Professor of Home Economics, Head of Department, Adviser of Women.
Harold W. Smart, LL.B.[2] . . . . Lincoln Block.
Instructor in Farm Law.
Richard W. Smith, Jr., B.Sc. . . . . 17 Fearing Street.
Instructor in Dairying.
Grant B. Snyder, B.Sc.Agr. . . . . Lincoln Block.
Instructor in Vegetable Gardening.
James L. Strahan, M.Sc. . . . . 50 Amity Street.
Assistant Professor of Rural Engineering.
Charles H. Thayer . . . . South East Street.
Instructor in Agronomy.
Clark L. Thayer, B.Sc. . . . . North Amherst.
Professor of Floriculture and Head of Department.
Weston C. Thayer, B.Sc. . . . . 14 Nutting Avenue.
Instructor in Animal Husbandry.
Charles H. Thompson, M.Sc. . . . . Mount Pleasant.
Professor of Horticulture.
Ray E. Torrey, Ph.D. . . . . Inwood.
Assistant Professor of Botany.
Ralph A. Van Meter, B.Sc. . . . . 7 East Pleasant Street.
Professor of Pomology.
Paul W. Viets . . . . Sunset Avenue.
Supervisor of Placement Training.
Frank A. Waugh, M.Sc. . . . . Campus.
Professor of Landscape Gardening, Head of Department, Head of Division of Horticulture.

[1] On leave of absence for one year. [2] Temporary for one year.

Winthrop S. Welles, B.Sc. . . . . 23 Lincoln Avenue.
Professor of Agricultural Education and Head of Department.
Chester H. Werkman, Ph.D. . . . . 23 Woodside Avenue.
Assistant Professor of Microbiology.
T. George Yaxis, M.Sc. . . . . 5 Sunset Avenue.
Assistant Professor of Dairying.
Hubert W. Yount, M.Sc. . . . . 9 Fearing Street.
Instructor in Agricultural Economics.

—— ——
Professor of Animal Husbandry and Head of Department.

—— ——
Professor of Economics and Sociology and Head of Department.

—— ——
Professor of Physics and Head of Department.

—— ——
Professor of Physics.

—— ——
Professor of Rural Sociology and Head of Department.

—— ——
Assistant Professor of Vegetable Gardening.

The Experiment Station Staff.

Edward M. Lewis, A.M. . . . . President's House.
Dean and Acting President of the College.
Sidney B Haskell, B.Sc. . . . . 2 Mount Pleasant.
Director.
James R. Alcock . . . . North Amherst.
Laboratory Assistant in Animal Nutrition.
Harry L. Allen . . . . 89 Main Street.
Laboratory Assistant in Chemistry.
Paul J. Anderson, Ph.D. . . . . 25 Lincoln Avenue.
Research Professor of Botany.
John G. Archibald, M.Sc. . . . . North Amherst.
Assistant Research Professor of Chemistry.
John S. Bailey, M.Sc. . . . . $13\frac{1}{2}$ Amity Street.
Investigator in Pomology.
Alyn S. Ball . . . . 94 Main Street.
Laboratory Assistant in Botany.
Arthur B. Beaumont, Ph.D. . . . . 51 Amity Street.
Professor of Agronomy and Head of Department.
Arthur I. Bourne, B.A. . . . . 12 East Pleasant Street.
Assistant Research Professor of Entomology.
Alexander E. Cance, Ph.D. . . . . 9 Fearing Street.
Professor of Agricultural Economics and Head of Department.
Walter W. Chenoweth, M.Sc. . . . . North Amherst.
Professor of Horticultural Manufactures and Head of Department.
Orton L. Clark, B.Sc. . . . . 12 College Street.
Assistant Professor of Botany.
William L. Doran, M.Sc. . . . . Waltham.
Assistant Research Professor of Botany.
F. Ethel Felton, B.A. . . . . The Davenport.
Editorial Assistant.
Henry T. Fernald, Ph.D. . . . . 44 Amity Street.
Professor of Entomology and Head of Department.
James A. Foord, M.Sc.Agr. . . . . 54 Lincoln Avenue.
Professor of Farm Management and Head of Department.
Henry J. Franklin, Ph.D. . . . . East Wareham.
Research Professor in charge of Cranberry Station.

George E. Gage, Ph.D. . . . . The Davenport
Professor of Animal Pathology and Head of Department of Veterinary Science and Animal Pathology.

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Assistant to the Director.

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Carleton P. Jones, M.Sc. . . . . 8 Nutting Avenue.
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Assistant Research Professor of Agronomy.

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Professor of Dairying and Head of Department.

Donald S. Lacroix, B.Sc. . . . . East Wareham.
Investigator in Agriculture.

Joseph B. Lindsey, Ph.D. . . . . 47 Lincoln Avenue.
Vice-Director, Professor of Chemistry and Head of Department.

Charles E. Marshall, Ph.D. . . . . 44 Sunset Avenue.
Professor of Microbiology and Head of Department.

Gladys I. Miner . . . . 1 Allen Street.
Curator, Department of Botany.

Fred W. Morse, M.Sc. . . . . 40 Pleasant Street.
Research Professor of Chemistry.

A. Vincent Osmun, M.Sc. . . . . 16 Northampton Road.
Professor of Botany and Head of Department.

John E. Ostrander, A.M., C.E. . . . . . . 33 North Prospect Street.
Meteorologist.

Norman J. Pyle, V.M.D. . . . . 5 Dana Street.
Assistant Research Professor of Avian Pathology.

Ruby Sanborn, A.B. . . . . 45 Pleasant Street.
Investigator in Poultry Husbandry.

Fred C. Sears, M.Sc. . . . . Mount Pleasant.
Professor of Pomology and Head of Department.

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Research Professor of Pomology.

Victor A. Tiedjens, M.Sc. . . . . Waltham.
Assistant Research Professor of Vegetable Gardening.

Frank A. Waugh, M.Sc. . . . . Campus.
Head of Division of Horticulture.

Chester H. Werkman, Ph.D. . . . . 23 Woodside Avenue.
Assistant Professor of Microbiology.

Harold E. Wilson . . . . 15 Phillips Street.
Laboratory Assistant in Pomology.

Harlan N. Worthley, M.Sc. . . . . Tillson Court.
Assistant Professor of Entomology.

——— ———
Investigator in Botany.

Control Service Staff.

Patrick E. Bransfield, B.A. . . . . 14 Nutting Avenue.
Analyst.
George B. Dalrymple . . . . 29 Main Street.
Analyst.
Henri D. Haskins, B.Sc. . . . . Easthampton.
Official Chemist, Fertilizer Control.
James T. Howard . . . . 7 Phillips Street.
Inspector.
Frank J. Kokoski, B.Sc. . . . . Northampton Road.
Analyst.
James J. McDermott . . . . 7 Woodside Avenue.
Technical Assistant.
Alice H. Norcross . . . . Abigail Adams House.
Analyst.
John J. Smith . . . . 9 Phillips Street.
Collector of Blood Samples.
Philip H. Smith, M.Sc. . . . . 102 Main Street.
Official Chemist, Feed Control.
Lewell S. Walker, B.Sc. . . . . 19 Phillips Street.
Assistant Official Chemist, Fertilizer Control.

Extension Service Staff.

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Dean and Acting President of the College.
John D. Willard, B.A. . . . . 31 Lincoln Avenue.
Director.
John B. Abbott, M.Sc. . . . . 31 North Prospect Street.
Extension Professor of Agronomy.
Fayette H. Branch, B.Sc. . . . . 31 East Pleasant Street.
Extension Professor of Farm Management.
William R. Cole . . . . 5 East Pleasant Street.
Assistant Extension Professor of Horticultural Manufactures.
John A. Crawford, B.Sc. . . . . 53 Lincoln Avenue.
Extension Editor.
George L. Farley, M.Sc. . . . . 61 Amity Street.
State Club Leader.
Clifford J. Fawcett, B.Sc. . . . . 70 Lincoln Avenue.
Extension Professor of Animal Husbandry.
Robert D. Hawley, B.Sc. . . . . South Amherst.
Supervisor of Extension Schools and Exhibits.
William F. Howe . . . . North Amherst.
Assistant State Club Leader.
Ray M. Koon, M.Sc. . . . . Waltham.
Extension Professor of Vegetable Gardening.
William P. B. Lockwood, M.Sc. . . . . West Newton.
Extension Professor of Dairying.
Robert J. McFall, Ph.D. . . . . 20 Spring Street.
Extension Professor of Agricultural Economics.
William C. Monahan, B.Sc. . . . . 8 Kellogg Avenue.
Extension Professor of Poultry Husbandry.
Earle H. Nodine, B.Sc. . . . . 21 Woodside Avenue.
Extension Instructor in charge of Poultry Club Work.
Sumner R. Parker, B.Sc. . . . . South Amherst.
Supervisor of County Agent Projects.
Ralph W. Redman, B.Sc. . . . . 3 Hallock Street.
Assistant Director.

Lucille W. Reynolds, B.Sc. . . . . 9 Phillips Street.
State Leader of Home Demonstration Agents.
Wilbur H. Thies, B.Sc. . . . . 50 Pleasant Street.
Assistant Extension Professor of Pomology.
Marion L. Tucker, B.Sc. . . . . 87 Pleasant Street.
Assistant Extension Professor of Home Economics.
Mildred L. Wood, A.B. . . . . 87 Pleasant Street.
Assistant Extension Professor of Nutrition.
Harriet M. Woodward, B.Sc. . . . . 87 Pleasant Street.
Assistant State Club Leader.
——— ———
Assistant Extension Professor of Landscape Gardening.

The Library Staff.

Henry S. Green, A.B., LL.D.[1] . . . . Mount Pleasant.
Librarian.
Basil B. Wood, A.B. . . . . The Davenport.
Librarian.
Lena V. Chapman . . . . 77 South Pleasant Street.
Assistant in charge of circulation.
Ethel A. Green, A.M. . . . . Mount Pleasant.
Library Assistant.
Katharine Powell . . . . 9 Amity Street.
Department Librarian.
Bessie M. Weymouth . . . . 19 Main Street.
Cataloguer.

Other Officers.

Baldassaros E. A. Bovenzi . . . . 61 Amity Street.
Engineer.
John K. Broadfoot . . . . 130 Pleasant Street.
Assistant to the Treasurer.
Avis P. Christopher . . . . Infirmary.
Resident Nurse.
Lawrence S. Dickinson, B.Sc. . . . . 2 Farview Way.
Superintendent of Grounds.
Lulu Diether . . . . Draper Hall.
Manager of the Dining Hall.
Samuel C. Hubbard . . . . North Amherst.
Foreman, Department of Floriculture.
Clarence A. Jewett . . . . 112 Pleasant Street.
Superintendent of Buildings.
John J. Lee . . . . 38 Cottage Street.
Assistant to the Military Detail.
Mrs. Mary Macrae . . . . Infirmary.
Matron.
Mrs. Marie B. Marsh . . . . Abigail Adams House.
Matron.
Ural V. Martin . . . . 79 Main Street.
Curator, Goessmann Laboratory.
William E. Martin . . . . 5 Phillips Street.
Laboratory Assistant, Department of Horticultural Manufactures.
Enos J. Montague, B.Sc. . . . . Campus.
Farm Superintendent.
Adelbert Sheffield . . . . North Amherst.
Superintendent of Dairy Manufactures.

[1] Retired Nov. 12, 1924.

Staff employed for Work for Federal Board for Vocational Education.

George L. Goodridge, B.Sc. . . . . . . 463 Lebanon Street, Melrose.
Supervisor of Agricultural Projects.
Frank L. Hannaford . . . . . . 44 Locust Street, Danvers.
Supervisor of Agricultural Projects.
Robert V. Mitchell . . . . Taunton, Mass.
Supervisor of Agricultural Projects.
Harold F. Williamson, B.Sc.Agr. . . . . 8 Kellogg Avenue.
Supervisor of Agricultural Projects.

Graduate Assistants.

Theodore T. Ayers, B.Sc. . . . . Clark Hall.
Department of Botany.
Eleanor F. Chase, B.Sc. . . . . Abigail Adams House.
Department of Chemistry.
Martin E. Cupery, A.B. . . . . West Experiment Station.
Department of Chemistry.
Mary J. Foley, B.Sc. . . . . 3 South Prospect Street.
Department of Agricultural Economics.
James Gibbard, Jr., B.S.A. . . . . North Amherst.
Department of Microbiology.
Henry Louwsma, A.B. . . . . 69 Lincoln Avenue.
Department of Chemistry.
Harry T. Mortensen, B.Sc. . . . . Sunderland.
Department of Microbiology.
Gordon P. Percival, B.Sc. . . . . 90 Pleasant Street.
Department of Chemistry.
Alwyn C. Sessions, B.Sc. . . . . 3 Nutting Avenue.
Department of Agronomy.
Harold H. Shepard, B.Sc. . . . . 120 Pleasant Street.
Department of Entomology.
Kenneth B. Simmons, B.Sc. . . . . 83 Pleasant Street.
Department of Landscape Gardening.
Orman E. Street, B.Sc. . . . . 3 Nutting Avenue.
Department of Agronomy.
Alexander H. Sumbardo, B.S.Agr. . . . . Poultry Plant.
Department of Poultry Husbandry.
Denis R. A. Wharton, B.S.A. . . . . 5 Sunset Avenue.
Department of Microbiology.
Gus C. Wofford, B.Sc. . . . . 83 Pleasant Street.
Department of Landscape Gardening.

Standing Committees of the Faculty.

1924-1925.

Commencement.

Professor Thayer.
Treasurer Kenney.
Secretary Watts.
Mr. S. R. Parker.
Asst. Professor Clark.

Course of Study.

Acting President Lewis.
Professor Waugh.
Professor Fernald.
Professor Ostrander.
Professor Marshall.
Professor Chamberlain.
Professor Foord.
Professor Welles.
Professor Glick.
Asst. Professor Julian.

Discipline.

Professor Mackimmie.
Professor Machmer.
Professor Chenoweth.
Professor Hicks.
Professor Gunness.

Employment.

Professor Judkins.
Treasurer Kenney.
Secretary Watts.
Professor Thayer.

Academic Activities Board.

Professor Waugh.
Asst. Professor Worthley.

Entrance Examinations and Admission.

Professor Machmer.
Professor Patterson.
Professor Osmun.
Professor Ashley.
Professor Glick.

Health and Sanitation.

Professor Marshall.
Treasurer Kenney.
Professor Gage.
Professor Hicks.
Miss Skinner.

Library.

Professor Marshall.
Professor Patterson.
Professor Cance.
Mr. Wood.

Scholarship.

Acting President Lewis.
Professor Machmer.
Professor Peters.
Professor Mackimmie.
Professor Patterson.
Professor Hicks.
Asst. Professor Rand.
Asst. Professor Torrey.
Asst. Professor Rice.

Student Life.

Professor Patterson.
Secretary Watts.
Professor Sears.
Professor Mackimmie.
Professor Thayer.
Professor Van Meter.

Athletic Board.

Professor Machmer.
Professor Osmun.
Asst. Professor Rice.

Admission.

A. Application for Admission.

Correspondence concerning admission should be addressed to the registrar.

Every applicant for admission to the college must be at least sixteen years old, and must present to the registrar proper testimonials of character, which, whenever possible, should come from the principal of the school at which the applicant has prepared for college. Candidates who desire to present themselves for examination in any subjects must make application to the college for such privilege at least one month before the date of the examination. Blanks for such application may be obtained by addressing the registrar of the college. All entrance credentials must be in the hands of the registrar before the applicant can matriculate.

B. Modes of Admission.

Students are admitted to the freshman class either upon certificate or upon examination. No *diploma* from a secondary school will be accepted.

Certificates. — The Massachusetts Agricultural College is affiliated with the New England College Entrance Certificate Board. Therefore certificates of admission will be accepted from schools approved by the Board. Certificates of admission will also be accepted from any Massachusetts school listed as class "A" by the State Department of Education, but not included in the approved lists of the New England College Entrance Certificate Board. Principals of schools in New England who desire the certificate privilege should address the secretary of the Board, Professor Frank W. Nicolson, Wesleyan University, Middletown, Conn. Certificates from schools outside of New England may be received if those schools are on the approved list of the leading colleges of the section in which the school in question is located.

The credentials of the Board of Regents of the State of New York are accepted as satisfying the entrance requirements of this college when offered subject for subject.

Certificates in order to be accepted must present in the prescribed and restrictive elective groups at least three of the necessary fourteen and one-half credits. It is to be understood, however, that responsibility for certification in either elementary French, elementary German, English 1 or English 2, Latin A, Greek A or algebra must be assumed by one school, if the candidate has received his preparation in any one subject named above in more than one school. Subjects lacking on certificate (except for the permitted number of conditions) must be made up at the time of the examinations for admission.

Special Certificate Arrangement for Students from Agricultural Schools. — Superior graduates of Vocational Schools of Agriculture in Massachusetts may be accepted for the Degree of Vocational Agriculture provided:

(*a*) they are unqualifiedly recommended by the Vocational Division of the State Department of Education;

(*b*) that they can present at least 14½ units of certified entrance credits.

Graduates of Vocational Agricultural Departments in Massachusetts High Schools may be admitted to the same degree course provided they present 14½ certified units of work. At least 7½ units must be in subjects listed in the "prescribed" and "restricted elective" groups certified to by the High School Principal in the regular way. The other 7 units will be accepted for work done in the

Agricultural Department and approved both as to quality and quantity by the State Department of Vocational Education.

Blank forms for certification — sent to principals or school superintendents only — may be obtained on application to the registrar of the college.

Examinations. — The examination in each subject may be oral or written, or both. The standard required for passing an examination for admission is 65 per cent. Conditions to the amount of two units will be allowed.

Entrance examination for admission to the Massachusetts Agricultural College will be held at the following centers: —

In June	Amherst, Department of Physics building.
	Massachusetts Institute of Technology, Cambridge, Mass.
	Worcester, Worcester Polytechnic Institute.
In September . . .	Amherst, Department of Physics building.

Please note that September examinations are held in Amherst only.

Schedule for Entrance Examinations June 18–20, 1925.

First Day.

8.30 A.M.	Algebra.
10.30 A.M.	Chemistry.
2.00 P.M.	History (ancient, medieval and modern, English, general, United States and Civics).

Second Day.

8.30 A.M.	English 1 and 2.
11.30–12.30 M.	Botany.
2.00 P.M.	Plane Geometry.
3.30 P.M.	Physics.

Third Day.

8.30 A.M.	French, German, Spanish, required and elective.
1.00 P.M.	Latin, elementary, intermediate and advanced, and all one-half credit electives, except those already noted.

Schedule for Entrance Examinations September 9–12, 1925.

First Day.

1.15–5.00 P.M.	Greek, elementary and intermediate.

Second Day.

8.30 A.M.	Algebra.
10.30 A.M.	Chemistry.
2.00 P.M.	History (ancient, medieval and modern, English, general, United States and Civics).

Third Day.

8.30 A.M.	English 1 and 2.
11.30–12.30 M.	Botany.
2.00 P.M.	Plane Geometry.
3.30 P.M.	Physics.

Fourth Day.

8.30 A.M.	French, German, Spanish, required and elective.
1.00 P.M.	Latin, elementary, intermediate and advanced, and all one-half credit electives, except those already noted.

C. Requirements for Admission.

The requirements for admission are based on the completion of a four-year high school course, or its equivalent, and are stated in terms of units. The term unit means the equivalent of at least four recitations a week for a school year.

Fourteen and one-half units must be offered for admission in accordance with the entrance requirements as stated below. Entrance credits gained either by certificate or by examination will hold good for one year.

Entrance Requirements.

1. *Prescribed.* — The following units are prescribed: —

English 1	1½
English 2	1½
A foreign language	2
Algebra	1½
Plane geometry	1
	7½

2. *Restricted Electives.* — Three units to be selected from —

Science	1, 2 or 3
History (American history and civics included)	1, 2 or 3
A second foreign language	2 or 3
Additional work, in first foreign language	1 or 2

3. *Free Margin.* — Free margin of four units to consist of any substantial work (including agriculture, general science and a fourth year of English) for which credit of not less than one-half unit earned in one year is given toward a secondary school diploma.

"Units presented in the free margin group in subjects not included in the examination schedule may be offered only by certificate."

4. One unit of history must be offered in either the restricted electives or the free margin.

5. If elementary algebra and plane geometry are counted as three units, the total requirement will be fifteen units.

6. Both the credits under the prescribed group and the restricted elective group must be presented either by certificate from an approved school or by examination, or by a combination of both.

The following is a list of subjects in which the entrance credits must be offered in the prescribed and restricted elective groups: —

Mathematics and Science.

Botany [1]	½ or 1
Chemistry [1]	1
Algebra	1½
Plane geometry	1
Solid geometry	½
Trigonometry	½
Physics [1]	1
Geology	½
Physical geography	½
Physiology	½
Zoölogy [1]	½

[1] Note-book required as part of the preparation will be credited as part of the examination.

History.

Ancient	1
Medieval and modern	1
English	1
General	1
United States and civics	1

English.

English 1	1½
English 2	1½

Foreign Language.

Elementary French	2
Elementary German	2
Elementary Spanish	2
Elementary Latin	2
Elementary Greek [1]	2
Intermediate French	1
Intermediate German	1
Intermediate Spanish	1
Intermediate Latin	1
Intermediate Greek [1]	1
Advanced French	1
Advanced German	1
Advanced Spanish	1
Advanced Latin	1

No applicant deficient in both algebra and plane geometry will be admitted.

PRESENTATION OF NOTE-BOOKS. — The keeping of a note-book is required as part of the preparation in those subjects indicated.

Candidates presenting themselves for examination in such subjects must present at the same time the required note-book, properly certified by the principal. Candidates presenting such subjects on certificates should not present note-books, but their certificates must state that note-books have been satisfactorily completed.

D. Statement of Preparation Required for Admission.

Agriculture. — Entrance credit in agriculture is granted on the following basis: —

I. The Massachusetts Agricultural College accepts a maximum of four credits in agriculture from any secondary or county agricultural high school in Massachusetts offering work in that subject, provided evidence of such work having been done is submitted on a principal's statement, as is indicated in the "free margin" group.

II. In high schools organizing agricultural club work under the supervision and rules of the junior extension service of the college, one credit is granted for each full year of work performed under the following plan: —

Work of the Winter Term. — (*a*) The study of textbooks such as are suitable for secondary school instruction in agriculture.

(*b*) Course of Study: A general outline of suggested topics for study.

(*c*) Visits by a representative of the Massachusetts Agricultural College for observation, counsel and advice in regard to kind and amount of work being done in agriculture.

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[1] Examination in September only.

(*d*) Formation of an agricultural club with officers from among its own members, meeting once a month under local supervision of some one authorized to act for the school authorities.

Work of the Spring Term. — Same in general form as winter term.

Work of the Summer Term. — An approved project conforming to the rules of some one or more of the agricultural clubs of the junior extension service of the Massachusetts Agricultural College.

Work of the Fall Term. — (*a*) An exhibit of work.

(*b*) Reports and story of achievement submitted to the junior extension service of the college.

The maximum number of credits in agriculture is four.

Botany. — For one unit of credit in botany, the work outlined in the statement of requirements issued by the College Entrance Examination Board, or its equivalent, will be accepted. This work should occupy one school year and include laboratory and supplementary textbook study. For one-half unit of credit, work that covers the same ground but occupies half the time required for a full unit of credit will be accepted. These requirements are met by such texts as Stevens' "Introduction to Botany" and Bergin & Davis' "Principles of Botany." A note-book containing neat, accurate drawings and descriptive records forms part of the requirement for either the half-unit or the one-unit credit, and this note-book must be presented by all applicants for admission upon examination in this subject. The careful preparation of an herbarium is recommended to all prospective students of this college, although the herbarium is not required.

Chemistry. — The entrance examination in chemistry will cover the work outlined by the College Entrance Examination Board as preparatory for college entrance. In general, this consists of a year of high school chemistry from any standard textbook, with laboratory work on the properties of the common elements and their simpler compounds. No particular work is prescribed. The keeping of a note-book is required.

Students who do not take chemistry in the preparatory school begin the subject in college, and are required to do extra work during the first two terms, as outlined under chemistry, courses 1 and 2, page 64.

Mathematics. — (*a*) *Required.* — Algebra: The four fundamental operations for rational algebraic expressions; factoring, determination of highest common factor and lowest common multiple by factoring; fractions, including complex fractions; ratio and proportion; linear equations, both numerical and literal, containing one or more unknown quantities; problems depending on linear equations; radicals, including the extraction of the square root of polynomials and numbers; exponents, including the fractional and negative; quadratic equations, both numerical and literal; simple cases of equations with one or more unknown quantities that can be solved by the methods of linear or quadratic equations; problems depending upon quadratic equations; the binomial theorem for positive integral exponents, the formulas for the nth term and the sum of the terms of arithmetic and geometric progressions, with applications.

Plane Geometry: The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurement of the circle; the solution of numerous original exercises, including loci problems; applications to the mensuration of lines and plane surfaces.

(*b*) *Elective.* — Solid Geometry: The usual theorems and constructions of good textbooks, including the relations of planes and lines in space; the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangle; the solution of numerous original exercises, including loci problems; applications to the mensuration of surfaces and solids.

Plane Trigonometry: A knowledge of the definitions and relations of trigonometric functions and of circular measurements and angles; proofs of the principal formulas and the application of these formulas to the transformation of the trigonometric functions; solution of trigonometric equations, the theory and use of logarithms, and the solution of right and oblique triangles.

Physics. — To satisfy the entrance requirement in physics, the equivalent of at least one unit of work is required. This work must consist of both classroom work and laboratory practice. The work covered in the class-room should be equal to that outlined in Hall & Bergen's "Textbook of Physics" or Millikan & Gale; the laboratory work should represent at least thirty-five experiments involving careful measurements, with accurate recording of each in laboratory note-book. This note-book, certified by the instructor in the subject, must be submitted by each candidate presenting himself for examination in physics; credit for passing the subject will be given on laboratory notes and on the examination submitted. Candidates entering on certificate will not be required to present note-books, but the principal's certification must cover laboratory as well as class-room work.

Physiology. — Hough & Sedgwick's "The Human Mechanism;" Martin's "The Human Body; Briefer Course."

Zoölogy, Physical Geography, Geology. — The following suggestions are made concerning preparation for admission in the subjects named above: —

For physiography, Davis' "Elementary Physical Geography;" Gilbert & Brigham's "Introduction to Physical Geography." For zoölogy, textbooks entitled "Animals" or "Animal Studies," by Jordan, Kellogg and Heath; Linville & Kelley's "A Textbook in General Zoölogy." For geology, A. P. Brigham's "A Textbook of Geology" or Tarr's "Elementary Geology."

Applicants for examination in zoölogy are *required* to present certified laboratory note-books; applicants for examination in the other subjects are *advised* to present note-books, if laboratory work has been done. Good note-books may be given credit for entrance. Examination in these subjects will be general, in recognition of the different methods of conducting courses; but students will be examined on the basis of the most thorough secondary school courses.

History. — The required unit must be offered in either ancient history, medieval and modern history, English history, general history, or United States history and civics. Either one, two or three elective units in any of the historical subjects here named may be offered, provided that no unit be offered in the same subject in which the required unit has been offered.

Preparation in history will be satisfactory if made in accordance with the recommendations of the committee of seven of the American Historical Association, as outlined by the College Entrance Examination Board. The examination will require comparisons and the use of judgment by the candidate rather than the mere use of memory, and it will presuppose the use of good textbooks, collateral reading and practice in written work. Geographical knowledge may be tested by requiring the location of places and movements on outline maps.

To indicate in a general way the character of the textbook work expected, the texts of the following authors are suggested: Botsford, Morey or Myers, in ancient history (to 814 A.D.); Adams, West or Myers, in medieval history; Montgomery, Larned or Cheyney, in English history; Myers or Fisher, in general history; Fiske, together with MacLaughlin or Montgomery, in United States history and civics.

English. — The study of English in school has two main objects, which should be considered of equal importance: (1) command of correct and clear English, spoken and written; (2) ability to read with accuracy, intelligence and appreciation, and the development of the habit of reading good literature with enjoyment.

(1) *Grammar and Composition* (One and One-half Units). — The first object requires instruction in grammar and composition. English grammar should ordinarily be reviewed in the secondary school; and correct spelling and grammatical accuracy should be rigorously exacted in connection with all written work during the four years. The principles of English composition governing punctuation, the use of words, sentences and paragraphs should be thoroughly mastered; and practice in composition, oral as well as written, should extend throughout the secondary school period. Written exercises may well comprise letter-writing, narration, description and easy exposition and argument. It is advisable that subjects for this work be taken from the student's personal experience, general knowledge and studies other than English, as well as from his reading in literature. Finally, special instruction in language and composition should be accompanied by con-

certed effort of teachers in all branches to cultivate in the student the habit of using good English in his recitations and various exercises, whether oral or written.

(2) *Literature* (One and One-half Units). — The second object is sought by means of two lists of books, headed, respectively, "Reading" and "Study," from which may be framed a progressive course in literature covering four years. In connection with both lists the student should be trained in reading aloud and encouraged to commit to memory some of the more notable passages both in verse and in prose. As an aid to literary appreciation, he is further advised to acquaint himself with the most important facts in the lives of the authors whose works he reads and with their place in literary history.

A. Books for Reading. — The aim of this course is to foster in the student the habit of intelligent reading and to develop a taste for good literature by giving him a first-hand knowledge of some of its best specimens. He should read the books carefully, but his attention should not be so fixed upon details that he fails to appreciate the main purpose and charm of what he reads.

The books provided for reading are arranged in the following groups, from each of which at least two selections are to be made, except that for any book in Group I a book from any other may be substituted.

Group I. Classics in Translation.

The "Old Testament," at least the chief narrative episodes in Genesis, Exodus, Joshua, Judges, Samuel, Kings and Daniel, together with the books of Ruth and Esther.
The "Odyssey," with the omission, if desired, of Books I–V, XV and XVI.
The "Æneid."
The "Odyssey" and the "Æneid" should be read in English translations of recognized literary excellence.

Group II. Drama.

Shakespeare: "Merchant of Venice," "As You Like It," "Julius Cæsar."

Group III. Prose Fiction.

Dickens: "A Tale of Two Cities."
George Eliot: "Silas Marner."
Scott: "Quentin Durward."
Hawthorne: "The House of the Seven Gables."

Group IV. Essays, Biography, etc.

Addison and Steele: "The Sir Roger de Coverley Papers."
Irving: "The Sketch Book," selections covering about 175 pages.
Macaulay: "Lord Clive."
Parkman: "The Oregon Trail."

Group V. Poetry.

Tennyson: "The Coming of Arthur," "Gareth and Lynette," "Lancelot and Elaine," "The Passing of Arthur."
Browning: "Cavalier Tunes," "The Lost Leader," "How They Brought the Good News from Ghent to Aix," "Home Thoughts from Abroad," "Home Thoughts from the Sea," "Incident of the French Camp," "Herve Riel," "Pheidippides," "My Last Duchess," "Up at a Villa — Down in the City," "The Italian in England," "The Patriot," "The Pied Piper," "De Gustibus," "Instans Tyrannus."
Scott: "The Lady of the Lake."
Coleridge: "The Ancient Mariner."
Arnold: "Sohrab and Rustum."

B. Books for Study. — This part of the requirement is intended as a natural and logical continuation of the student's earlier reading, with greater stress laid upon form and style, the exact meaning of words and phrases, and the understanding of allusions.

The books provided for study are arranged in four groups, from each of which one selection is to be made.

Group I. Drama.

Shakespeare: "Macbeth," "Hamlet."

Group II. Poetry.

Milton: "L'Allegro," "Il Penseroso," "Comus."
Book IV of Palgrave's "Golden Treasury" (first series), with special attention to Wordsworth, Keats and Shelley.

Group III. Oratory.

Burke: "Speech on Conciliation with America."
Washington's "Farewell Address," Webster's "First Bunker Hill Oration," and Lincoln's "Gettysburg Address."

Group IV. Essays.

Macaulay: "Life of Johnson."
Carlyle: "Essay on Burns," with a brief selection from Burns' poems.

Examination. — However accurate in subject-matter, no paper will be considered satisfactory if seriously defective in punctuation, spelling or other essentials of good usage.

The examination will be divided into two parts, one of which will be on grammar and composition, and the other on literature.

In grammar and composition, the candidate may be asked specific questions upon the practical essentials of these studies, such as the relation of the various parts of a sentence to one another, the construction of individual words in a sentence of reasonable difficulty, and those good usages of modern English which one should know in distinction from current errors. The main test in composition will consist of one or more essays, developing a theme through several paragraphs; the subjects will be drawn from the books read, from the candidate's other studies and from his personal knowledge and experience quite apart from reading.

The examination in literature will include: —

(*a*) General questions designed to test such a knowledge and appreciation of literature as may be gained by fulfilling the requirements defined under "A, Reading," above.

(*b*) A test on the books prescribed for study, which will consist of questions upon their content and structure, and upon the meaning of such words, phrases and allusions as may be necessary to an understanding of the works and an appreciation of their salient qualities of style. General questions may also be asked concerning the lives of the authors, their works and the periods of literary history to which they belong.

French. — Elementary: The necessary preparation for this examination is stated in the description of the two-year course in elementary French recommended by the Modern Language Association, contained in the definition of requirements of the College Entrance Examination Board.

Third and fourth year French (elective subjects for admission). — For a third credit unit in French as an elective subject for entrance, the work heretofore described by the College Entrance Examination Board as "intermediate" is expected. For a fourth credit unit, the work described as "advanced" is expected.

No examination for a third unit in French will be given unless the candidate has presented elementary French on certificate, or has written the examination in elementary French.

No examination for a fourth credit in French will be given unless the candidate has presented both elementary and intermediate French upon certificate, or has written the examination in both elementary and intermediate French.

German. — Elementary: The entrance requirements in German conform to those of the College Entrance Examination Board for elementary German (the standard two-year requirements).

Third and fourth year German (elective subjects for admission). — For a third credit unit in German as an elective subject for entrance, when required units have been offered in German, the work heretofore described by the College Entrance Examination Board as "intermediate" is expected. For a fourth credit unit, the work described as "advanced" is expected.

No examination for a third unit in German will be given unless the candidate has presented elementary German upon certificate, or has written the examination in elementary German.

No examination for a fourth credit in German will be given unless the candidate has presented both elementary and intermediate German upon certificate, or has written the examination for both elementary and intermediate German.

Spanish. — Elementary: The necessary preparation for this examination is stated in the description of the two-year course in elementary Spanish recommended by the Modern Language Association, contained in the definition of requirements of the College Entrance Examination Board.

Third and fourth year Spanish (elective subjects for admission). — For a third credit unit in Spanish as an elective subject for entrance, the work heretofore described by the College Entrance Examination Board as "intermediate" is expected. For a fourth credit unit, the work described as "advanced" is expected.

No examination for a third unit in Spanish will be given unless the candidate has presented elementary Spanish on certificate, or has written the examination in elementary Spanish.

No examination for a fourth credit in Spanish will be given unless the candidate has presented both elementary and intermediate Spanish upon certificate, or has written the examination in both elementary and intermediate Spanish.

Greek. — *Elementary.* — Greek grammar and composition: Translation into Greek of short sentences illustrating common principles of syntax.

The examination in grammar and prose composition will be based on the first four books of Xenophon's "Anabasis."

Intermediate. — Homer's "Iliad," Books I and II (omitting Book II, 494 to end), and the Homeric forms, constructions, idioms and prosody.

Prose composition, consisting of continuous prose based on Xenophon, and other Attic prose of similar difficulty.

Translation of passages of Homer at sight.

The examinations in Greek, elementary and intermediate, will be given in September only.

Latin. — *Elementary.* — Two credit units will be allowed if satisfactory proficiency is shown (including grammar) in (*a*) the translation of a passage or passages taken from Cæsar's "Gallic War," covering at least four books, and (*b*) the translation of passages of Latin prose at sight.

Intermediate. — Cicero (third oration "Against Catiline" and the orations "For Archias" and "For Marcellus") and sight translation of prose.

Advanced. — Vergil (Æneid, II, III and VI) and sight translation of poetry.

E. Admission to Advanced Standing.

Candidates for admission to advanced standing, in addition to meeting the regular entrance requirements, must also pass examinations in those subjects already pursued by the class they desire to enter. To meet this requirement, a student transferring to this college from another college or university of recognized standing must present the following credentials: —

1. A letter of honorable dismissal from the institution with which he has been connected.

2. A statement or certificate of his entrance record.
3. A statement from the proper officer showing a complete record of his work while in attendance.
4. A marked catalogue showing the courses pursued.
5. A statement from the proper officer, giving the total number of credits required for graduation by the institution from which the applicant is transferring, and, of this total, the number that the applicant has satisfactorily completed at the time of transfer.

These credentials should be presented to the registrar. Applications will be judged wholly on their merits and the college may prescribe additional tests before accepting applicants or determining the standing to be granted them.

F. Other Information about Entrance.

1. The privileges of the college may be withdrawn from any student at any time if such action is deemed advisable. (It is immaterial whether the pupil has entered by certificate or by examination.)
2. The examination in each subject may be either oral or written, or both. The standard required for passing an entrance examination is 65 per cent.
3. To matriculate, candidates must offer twelve and one-half of the fourteen and one-half units required for admission, and will be conditioned in those subjects not passed. At least five and one-half credits must be in the prescribed group. No candidate deficient in both algebra and plane geometry will be admitted.
4. Examinations for the removal of entrance conditions will be held during the first week of the second term.
5. Credits for entrance requirements, whether gained by certificate or by examination, will hold good for one year.
6. Examinations in part of the subjects required for entrance may be taken one year before entering college.
7. For information concerning expenses, scholarships, etc., see "General Information."
8. For information concerning admission to short courses, see "Short Courses."
9. Application for admission as a "Special Student" should be made to the Dean.

Courses of Instruction.

FRESHMAN YEAR.

Table of Freshman Subjects.

[The figures indicate the number of credit hours per week. Freshman credit is computed on the basis of total clock hours per week spent in class room and study. Groups A and B of each term are required of all Freshman men; groups A and C of all Freshman women. For details, see the following tables of the first, second, and third terms, and the description of the courses.]

First Term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
Agriculture 1	1	2	2	5
Chemistry 1	3	4	5	12
or				
Chemistry 4	2	4	4	10
English 1	3	–	5	8
Language 1 or 4 (French or German)	3	–	6	9
Mathematics 1 (Algebra)	4	–	6	10
Group B; for men:				
Military 1 (or Physical Education 7)	–	3	2	5
Physical Education 1	1	–	–	1
Physical Education 2	–	2	–	2
Group C; for women:				
Rural Home Life 1	2	–	–	2
Physical Education 4	–	3	–	3

Second Term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
Agriculture 2	1	2	2	5
Chemistry 2	3	4	5	12
or				
Chemistry 5	2	4	3	9
English 2	3	–	5	8
Language 2 or 5 (French or German)	3	–	5	8
Mathematics 2 (Higher Algebra)	3	–	4	7
or				
Mathematics 3 (Solid Geometry)	3	–	4	7
Mathematics 4 (Mensuration)	2	–	3	5
Group B; for men:				
Military 2 (or Physical Education 8)	–	3	2	5
Group C; for women:				
Physical Education 5	–	3	–	3

Third Term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
Agriculture 3	1	2	2	5
Botany 3	2	4	4	10
English 3	3	-	6	9
Language 3 or 6 (French or German)	3	-	6	9
Mathematics 5 (Trig.)	3	-	6	9
Group B; for men:				
Military 3 (or Physical Education 9)	-	3	2	5
Physical Education 3	-	2	-	2
Group C; for women:				
Physical Education 6	-	3	-	3

SOPHOMORE YEAR.

Table of Sophomore Subjects.

[The figures indicate the number of credit hours per week. Sophomore credit is computed on the basis of total clock hours per week spent in class room and study. Groups A and B of each term are required of all Sophomore men; groups A and C, of all Sophomore women. In addition, one of the "Divisional Elective Groups" is to be elected as a unit by each Sophomore. For details, see the following tables of the first, second, and third terms, and the description of the courses.]

First Term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
Botany 25	1	4	2	7
English 25	2	-	4	6
English 28	1	-	2	3
Physics 25	3	2	4	9
Group B; for men:				
Military 25 (or Physical Education 30)	-	3	2	5
Physical Education 25	-	2	-	2
Group C; for women:				
Rural Home Life 25	1	4	-	5
Physical Education 27	-	3	-	3
Divisional Elective Groups.				
Agriculture:				
Animal Husbandry 25	2	2	3	7
Agronomy 25	2	4	3	9
Horticulture:				
Chemistry 25	1	4	4	9
Drawing 25	-	8	-	8
Science:				
Modern Language (French or German)	3	-	5	8
Chemistry 25	1	4	4	9
Rural Social Science:				
Animal Husbandry 29	2	2	3	7
Economics 25	3	-	6	9

Second Term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
English 26	2	–	4	
English 29	1	–	2	
Zoölogy 26	2	4	3	
Group B; for men:				
Military 26 (or Physical Education 31)	–	3	2	
Group C; for women:				
Agriculture 26	2	–	1	3
Physical Education 28	–	3	–	3
Divisional Elective Groups.				
Agriculture:				
Animal Husbandry 26	2	2	3	7
Chemistry 30	3	4	3	10
Physics 26	3	2	4	9
Horticulture:				
Physics 26	3	2	4	9
Drawing 26	–	6	–	6
Agricultural Economics 26	4	2	6	12
Science:				
Modern Language (French or German)	3	–	5	8
Physics 26	3	2	4	9
Chemistry 26	1	4	4	9
Rural Social Science:				
Agricultural Economics 26	4	2	6	12
Agricultural Education 29	3	–	3	6
American Government 25	3	–	5	8
Landscape Gardening:				
Physics 26	3	2	4	9
Mathematics 26	3	–	6	9
Drawing 26	–	6	–	6

Third Term.

Course and Number.	Class Hours.	Laboratory Hours.	Study Hours.	Credit in Clock Hours per Week.
Required Groups.				
Group A; for men and women:				
English 27	2	-	4	6
Group B; for men:				
Military 27 (or Physical Education 32)	-	3	2	5
Physical Education 26	-	2	-	2
Group C; for women:				
Rural Home Life 27	1	4	-	5
Physical Education 29	-	3	-	3
Divisional Elective Groups.				
Agriculture:				
Agronomy 27	4	2	3	9
Microbiology 30	-	6	-	6
Rural Engineering 27	-	4	-	4
Rural Engineering 30	-	8	-	8
or				
Physics 27	3	2	4	9
English 30	1	-	2	3
Citizenship 27	2	-	4	6
Horticulture:				
Agronomy 27	4	2	3	9
Entomology 28	2	6	1	9
Physics 27	3	2	4	9
English 30	1	-	2	3
Citizenship 27	2	-	4	6
Science:				
Modern Language (French or German)	3	-	6	9
Physics 27	3	2	4	9
Entomology 26	5	-	4	9
or				
Entomology 28	2	6	1	9
Botany 26	1	6	2	9
Rural Social Science:				
Rural Sociology 27	3	-	6	9
Agronomy 27	4	2	3	9
Entomology 26	5	-	4	9
English 30	1	-	2	3
Citizenship 27	2	-	4	6
Landscape Gardening:				
Mathematics 27	-	6	4	10
Drawing 27	-	8	-	8
Entomology 28	2	6	1	9
English 30	1	-	2	3
Citizenship 27	2	-	4	6

MAJORS: JUNIOR AND SENIOR YEARS.

General Statement.

A major consists of 150 credit hours of correlated work, which is arranged by the student and his adviser.

The list of courses found under each major on subsequent pages should not be considered as necessarily a rigid program to be followed. The heads of departments have suggested this series of courses as the best for the average man majoring in their departments. Advisers may, however, make modifications to suit the particular needs of the student, provided these modifications conform precisely to the class schedule as published for the year.

Rules governing Majors.

Rule 1. *Election.* — Each student, before the first term of his junior year, shall elect a major subject from the list of majors given below; and this major shall consist of 150 credit hours of correlated work.

Rule 2. *Minimum Credits.* — The minimum number of credits for graduation shall be 288 junior-senior credit-hours in addition to the satisfactory completion of the required courses of the freshman year and of the required and elective groups of the sophomore year.

Rule 3. *Maximum Credits.* — The maximum number of credits for any term of the junior or senior year shall be 54; the minimum shall be 45.

Rule 4. *Humanities and Rural Social Science.* — A minimum of 54 credit hours in the Divisions of the Humanities and Rural Social Science will be required of all students during their junior and senior years, with the following restriction: that a minimum of 12 credit hours will be required in each of the divisions.

Rule 5. *Advisers.* — The work of each junior and senior will be under the immediate supervision of an instructor designated as major adviser. Ordinarily, the major adviser will be the head of the department in which the student elects his major. The adviser has full authority to prescribe the student's work up to 150 hours. He will, however, so far as practicable, recognize the individual needs of the student. It is also expected that students will seek the counsel of the adviser with respect to the remaining courses required for graduation.

Rule 6. *Free Electives.* — Each student during his junior and senior years is required to take 150 hours in his major and also 54 hours in the Divisions of the Humanities and Rural Social Science, making a total of 204 hours (but see Rule 4). He is allowed free choice of courses to complete his required hours.

Rule 7. *Registration.* — No junior or senior shall register until his major course of study is approved by his adviser.

(1) Course cards for recording the election of majors will be issued from the Schedule Room five weeks before the close of each term.

(2) This card must be submitted by each student to his major adviser, who will lay out the course for the succeeding term and countersign the card.

(3) Each course card must be filled out, giving the name of student, his major, his class and the name and address of parent or guardian. When the major courses have been entered on this card, and the hours of free elections added by the student, the card, accompanied by one hour plan, must be returned to the Schedule Room two weeks before the beginning of the final examination period.

Rule 8. *Change of Major.* — Applications for change of major may be made to the dean in writing at any time; when approved by both major advisers concerned and by the dean and the committee on scholarship, they become operative at the beginning of the term following, provided that no change in the selection of a major may be made by any student after registration day of his senior year.

Agronomy. (Major.)

Professor Arthur B. Beaumont, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agronomy	50 **I.**	10
Agronomy	51 **III.**	7
Agronomy	75 **I.**	10
Agronomy	77 **II.**	10
Agronomy	78 **II.**	7
Animal Husbandry	50 **I.**	7
Chemistry	51 **I.**	12
Chemistry	52 **II.**	12
Farm Management	76 **I.**	8
Farm Management	77 **III.**	7
		90

Term.	Junior.	Credit.	Senior.	Credit.
I.	Agronomy 50	10	Agronomy 75	10
	Animal Husbandry 50	7	Farm Management 76	8
	Chemistry 51	12		
II.	Chemistry 52	12	Agronomy 77	10
			Agronomy 78	7
III.	Agronomy 51	7	Farm Management 77	7

Animal Husbandry. (Major.)

Professor —— ——, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agronomy	50 **I.**	10
Agronomy [1]	51 **III.**	7
Agronomy [1]	77 **II.**	10
Animal Husbandry	50 **I.**	7
Animal Husbandry	51 **II.**	7
Animal Husbandry	52 **III.**	7
Animal Husbandry	53 **III.**	10
Animal Husbandry	75 **I.**	7
Animal Husbandry	76 **II.**	7
Animal Husbandry	77 **III.**	7
Animal Husbandry	81 **II.**	2
Animal Husbandry	82 **III.**	2
Dairying	50 **I.**	10
Dairying [1]	52 **III.**	10
Farm Management	51 **II.**	7
Farm Management	76 **I.**	8
Farm Management [1]	81 **III.**	6
Poultry [1]	78 **III.**	10
Rural Engineering [1]	75 **I.**	10
Rural Engineering [1]	78 **II.**	10
Veterinary	50 **II.**	8
Veterinary	75 **I.**	
or		
Veterinary	78 **I.**	8
Veterinary	76 **II.**	
or		
Veterinary	79 **II.**	8
Veterinary	77 **III.**	
or		
Veterinary	80 **III.**	8
		178 [2]

Term.	Junior.	Credit.	Senior.	Credit.
I.	Agronomy 50	10	Animal Husbandry 75	7
	Animal Husbandry 50	7	Farm Management 76	8
	Dairy 50	10	Rural Engineering 75 [1]	10
			Veterinary 75 or 78	8
II.	Animal Husbandry 51	7	Agronomy 77 [1]	10
	Farm Management 51	7	Animal Husbandry 76	7
	Veterinary 50	8	Animal Husbandry 81	2
			Rural Engineering 78 [1]	10
			Veterinary 76 or 79	8
III.	Agronomy 51 [1]	7	Animal Husbandry 77	7
	Animal Husbandry 52	7	Animal Husbandry 82	2
	Animal Husbandry 53	10	Farm Management 81 [1]	6
	Dairying 52 [1]	10	Poultry 78 [1]	10
			Veterinary 77 or 80	8

[1] Suggested, but not required.

[2] Only 115 credit-hours required.

DAIRYING. (Major.)

Professor HENRY F. JUDKINS, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Economics	53 **III.**	12
Agricultural Economics[1]	75 **II.**	12
Agricultural Economics[1]	76 **II.**	12
Agricultural Economics[1]	83 **I.**	6
Agricultural Economics[1]	84 **III.**	6
Agricultural Education	51 **I.**	10
Animal Husbandry	50 **I.**	7
Animal Husbandry	81 **II.**	2
Animal Husbandry	82 **III.**	2
Chemistry	25 **I.**	9
Chemistry	61 **I.**	12
Chemistry	63 **III.**	12
Dairying	50 **I.**	10
Dairying	51 **II.**	4
Dairying	52 **III.**	10
Dairying	75 **I.**	5
Dairying	76 **I.**	9
Dairying	77 **II.**	10
Dairying	78 **III.**	10
Economic Sociology[1]	51 **II.**	12
Economic Sociology[1]	52 **III.**	12
Farm Management[1]	51 **II.**	7
Microbiology	51 **II.**	10
Microbiology	82 **I.**	10
Rural Engineering[1]	81 **III.**	4
Rural Sociology[1]	51 **II.**	9
Veterinary Science[1]	50 **II.**	8
		232[2]

Term.	Junior.	Credit.	Senior.	Credit.
I.	Agricultural Education 51[1]	10	Agricultural Economics 83[1]	6
	Animal Husbandry 50	7	Chemistry 61	12
	Chemistry 25	9	Dairying 75	5
	Dairying 50	10	Dairying 76	9
			Microbiology 82	10
II.	Dairying 51	4	Agricultural Economics 75[1]	12
	Economic Sociology 51[1]	12	Agricultural Economics 76	12
	Microbiology 51	10	Animal Husbandry 81	2
	Rural Sociology 51[1]	9	Dairying 77	10
	Veterinary Science 50[1]	8	Farm Management 51[1]	7
III.	Dairying 52	10	Agricultural Economics 53	12
	Economic Sociology 52[1]	12	Agricultural Economics 84[1]	6
	Rural Engineering 81[1]	4	Animal Husbandry 82	2
			Chemistry 63	12
			Dairying 78	10

[1] Suggested, but not required.

[2] Only 146 credit-hours required.

FARM MANAGEMENT. (Major.)

Professor JAMES A. FOORD, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agronomy	50 **I.**	10
Agronomy[1]	51 **III.**	7
Agronomy	77 **II.**	10
Animal Husbandry	50 **I.**	7
Animal Husbandry	51 **II.**	7
Animal Husbandry[1]	52 **III.**	7
Animal Husbandry	53 **III.**	10
Animal Husbandry[1]	75 **I.**	7
Animal Husbandry[1]	76 **II.**	7
Animal Husbandry	77 **III.**	7
Dairying	50 **I.**	10
Dairying[1]	52 **III.**	10
Farm Management	51 **II.**	7
Farm Management	76 **I.**	8
Farm Management	77 **III.**	7
Farm Management	78 **II.**	2
Farm Management	79 **III.**	2
Farm Management[1]	81 **III.**	6
Forestry	58 **III.**	8
Pomology	50 **I.**	7
Pomology	51 **II.**	7
Pomology[1]	78 **III.**	8
Poultry[1]	78 **III.**	10
Rural Engineering	75 **I.**	10
Rural Engineering	78 **II.**	10
Rural Engineering	79 **III.**	10
Veterinary	75 **I.**	8
		209[2]

Term.	Junior.	Credit.	Senior.	Credit.
I.	Agronomy 50	10	Animal Husbandry 75[1]	7
	Animal Husbandry 50	7	Farm Management 76	8
	Dairying 50	10	Rural Engineering 75	10
	Pomology 50	7	Veterinary 75	8
II.	Animal Husbandry 51	7	Agronomy 77	10
	Farm Management 51	7	Animal Husbandry 76[1]	7
	Pomology 51	7	Farm Management 78	2
			Rural Engineering 78	10
III.	Agronomy 51[1]	7	Animal Husbandry 77	7
	Animal Husbandry 52[1]	7	Farm Management 77	7
	Animal Husbandry 53	10	Farm Management 79	2
	Dairying 52[1]	10	Farm Management 81[1]	6
	Forestry 58	8	Pomology 78[1]	8
			Poultry 78[1]	10
			Rural Engineering 79	10

[1] Suggested, but not required.

[2] Only 147 credit-hours required.

Poultry Husbandry. (Major.)

Professor John C. Graham, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Economics	53 **III.**	12
Agronomy	50 **I.**	10
Animal Husbandry	50 **I.**	7
Farm Management	51 **II.**	7
Poultry Husbandry	50 **I.**	10
Poultry Husbandry	51 **II.**	10
Poultry Husbandry	52 **III.**	10
Poultry Husbandry	75 **I.**	6
Poultry Husbandry	76 **I.**	8
Poultry Husbandry	77 **II.**	10
Poultry Husbandry	79 **III.**	8
Veterinary Science	85 **I.**	8
Veterinary Science	86 **II.**	8
Veterinary Science	87 **III.**	8
		122

Term.	Junior.	Credit.	Senior.	Credit.
I.	Agronomy 50	10	Poultry 75	6
	Animal Husbandry 50	7	Poultry 76	8
	Poultry 50	10	Veterinary 85	8
II..	Poultry 51	10	Farm Management 51	7
			Poultry 77	10
			Veterinary 86	8
III.	Agricultural Economics 53	12	Poultry 79	8
	Poultry 52	10	Veterinary 87	8

Strongly Advised. — Microbiology 50 I, Zoölogy 76 II.

Floriculture.

Professor Clark L. Thayer, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Botany	50 **I.**	6
Botany	51 **II.**	6
Floriculture	50 **I.**	9
Floriculture	51 **II.**	9
Floriculture	52 **III.**	9
Floriculture	53 **I.**	8
Floriculture	55 **III.**	7
Floriculture	75 **I.**	7
Floriculture	76 **II.**	7
Floriculture	77 **III.**	7
Floriculture	79 **II.**	8
Floriculture	80 **III.**	5–9
Horticulture	50 **I.**	10
Horticulture	51 **III.**	10
		108–112

Term.	Junior.	Credit.	Senior.	Credit.
I.	Botany 50	6	Floriculture 75	7
	Floriculture 50	9	Horticulture 50	10
	Floriculture 53	8		
II.	Botany 51	6	Floriculture 76	7
	Floriculture 51	9	Floriculture 79	8
III.	Floriculture 52	9	Floriculture 77	7
	Floriculture 55	7	Floriculture 80	5–9
			Horticulture 51	10

Advised. — The department advises all students who major in this subject to take Entomology 50, Landscape Gardening 75, Botany 78, 79 and 80, and Agricultural Economics 53 and 83.

Landscape Gardening. (Major.)

Professor Frank A. Waugh, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Floriculture	55 **III.**	7
Horticulture	50 **I.**	10
Horticulture	51 **III.**	10
Landscape Gardening	50 **I.**	10
Landscape Gardening	51 **II.**	11
Landscape Gardening	52 **III.**	12
Landscape Gardening	75 **I.**	6
Landscape Gardening	76 **I.**	10
Landscape Gardening	77 **III.**	12
Landscape Gardening	78 **I.**	9
or		
Landscape Gardening	79 **I.**	9
Landscape Gardening	80 **II.**	12
Landscape Gardening	81 **II.**	12
Landscape Gardening	82 **III.**	12
		133

Term.	Junior.	Credit.	Senior.	Credit.
I.	Horticulture 50	10	Landscape Gardening 75	6
	Landscape Gardening 50	10	Landscape Gardening 76	10
	Landscape Gardening 78 or 79	9	Landscape Gardening 78 or 79	9
II.	Landscape Gardening 51	11	Landscape Gardening 80	12
			Landscape Gardening 81	12
III.	Floriculture 55	7	Landscape Gardening 77	12
	Horticulture 51	10	Landscape Gardening 82	12
	Landscape Gardening 52	12		

Additional Information. — Modifications may be permitted when they appear advisable.

Pomology. (Major.)

Professor Fred C. Sears, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Economics	53 **III.**	12
Agronomy	77 **II.**	10
Botany	50 **I.**	6–10
Horticultural Manufactures	75 **I.**	12
Horticultural Manufactures	76 **II.**	8
Pomology	50 **I.**	7
Pomology	51 **II.**	7
Pomology	52 **III.**	7
Pomology	54 **II.**	8
Pomology	75 **I.**	8
Pomology	76 **II.**	7
Pomology	77 **I.**	8
Pomology	78 **III.**	8
Pomology	80 **I.**	2
Pomology	81 **II.**	2
Pomology	82 **III.**	2
Rural Engineering	78 **III.**	10
		124–128

Term.	Junior.	Credit.	Senior.	Credit.
I.	Botany 50	6–10	Horticultural Manuf. 75	12
	Pomology 50	7	Pomology 75	8
			Pomology 77	8
			Pomology 80	2
II.	Pomology 51	7	Agronomy 77	10
	Pomology 54	8	Horticultural Manuf. 76	8
			Pomology 76	7
			Pomology 81	2
III.	Agricultural Economics 53	12	Pomology 78	8
	Pomology 52	7	Pomology 82	2
			Rural Engineering 78	10

Vegetable Gardening. (Major.)

Professor Frank A. Waugh, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agronomy	75 **I.**	10
Agronomy	77 **II.**	10
Botany	50 **I.**	6
Botany	51 **II.**	6
Vegetable Gardening	52 **II.**	10
Vegetable Gardening	53 **III.**	10
Vegetable Gardening	75 **I.**	10
Vegetable Gardening	76 **II.**	10
Vegetable Gardening	77 **III.**	10
		82

Term.	Junior.	Credit.	Senior.	Credit.
I.	Agronomy 75	10	Vegetable Gardening 75	10
	Botany 50	6		
II.	Agronomy 77	10	Vegetable Gardening 76	10
	Botany 51	6		
	Vegetable Gardening 52	10		
III.	Vegetable Gardening 53	10	Vegetable Gardening 77	10

Economic Botany. (Major.)

Professor A. Vincent Osmun, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Education	56 **III.**	10
Agronomy	50 **I.**	10
Botany	52 **I.**	7
Botany	53 **II.**	7
Botany	54 **III.**	7
Botany	55 **III.**	10
Botany	58 **I.**	8
or		
Botany	61 **I.**	8
Botany	59 **II.**	8
or		
Botany	62 **II.**	8
Botany	60 **III.**	8
or		
Botany	63 **III.**	8
Botany	75 **I.**	11
Botany	76 **II.**	11
Botany	77 **III.**	11
Botany	78 **I.**	10
Botany	79 **II.**	6 or 10
Botany	80 **III.**	6 or 10
Chemistry	51 **I.**	12
Chemistry	52 **II.**	12
Chemistry	80 **I.**	10
Chemistry	86 **II**	9
English	52 **III.**	9
English	65 **I.**	9
Entomology	51 **II.**	6
Entomology	90 **II.**	7
French or German	50 **I.**	9
French or German	51 **II.**	9
French or German	52 **III.**	9
Geology	52 **III.**	10
		265–273[1]

Term.	Junior.	Credit.	Senior.	Credit.
I.	Agronomy 50	10	Botany 58 or 61	8
	Botany 52 or	7	Botany 75 or	11
	Botany 58 or 61	8	Botany 78	10
	Chemistry 51	12	Chemistry 80	10
	English 65	9		
	French or German 50	9		
II.	Botany 53 or	7	Botany 59 or 62	8
	Botany 59 or 62	8	Botany 76 or	11
	Chemistry 52	12	Botany 79	6 or 10
	Entomology 51	6	Chemistry 86	9
	French or German 51	9	Entomology 90	7
III.	Agricultural Education 56	10	Botany 60 or 63	8
	or		Botany 77 or	11
	English 52	9	Botany 80	6 or 10
	Botany 54 or	7	Agricultural Education 56	10
	Botany 60 or 63	8		
	Botany 55	10		
	French or German 52	9		
	Geology 52	10		

[1] A student is required to select, in consultation with his major adviser, at least 150 credits from this list.

Agricultural Chemistry. (Major.)

Professor Charles A. Peters, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Chemistry	51 **I.**	12
Chemistry	52 **II.**	12
Chemistry	53 **III.**	12
Chemistry	61 **I.**	12
Chemistry	62 **II.**	12
Chemistry	63 **III.**	12
Chemistry	75 **I.**	12
Chemistry	80 **I.**	10
Chemistry	86 **II.**	9
Chemistry	87 **III.**	9
Chemistry	90 **II.**	
Chemistry	92 **II.**	12
Chemistry	94 **II.**	
Chemistry	91 **III.**	
Chemistry	93 **III.**	12[1]
Chemistry	95 **III.**	
		136

Term.	Junior.	Credit.	Senior.	Credit.
I.	Chemistry 51	12	Chemistry 75	12
	Chemistry 61	12	Chemistry 80	10
II.	Chemistry 52	12	Chemistry 86	9
	Chemistry 62	12	Chemistry 90, 92, 94	12
III.	Chemistry 53	12	Chemistry 87	9
	Chemistry 63	12	Chemistry 91, 93, 95	12

A knowledge of German is required. Students having had no German previously should elect it at the beginning of the sophomore year.

[1] Students will select one course from groups 90, 92, 94, and 91, 93, 95, respectively.

Economic Entomology. (Major.)

Professor Henry T. Fernald, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Botany	51 **II.**	8
Chemistry	80 **I.**	10
Entomology	52 **I.**	8
Entomology	53 **I.**	12
Entomology	54 **I.**	4
Entomology	55 **II.**	8
Entomology	56 **II.**	6
Entomology	65 **III.**	8
Entomology	75 **III.**	8
Entomology	76 **I.**	11
Entomology	77 **II.**	12
Entomology	78 **III.**	9
Entomology	85 **I.**	7
Entomology	90 **II.**	7
Geology	52 **III.**	10
Zoölogy	50 **I.**	7
Zoölogy	51 **II.**	7
Zoölogy	52 **III.**	7
		149

Term.	Junior.	Credit.	Senior.	Credit.
I.	Chemistry 51[1]	12	Chemistry 80	10
	Entomology 52	8	Entomology 76	11
	Entomology 53	12	Entomology 85	7
	Entomology 54	4	Horticulture 50[1]	10
	French or German 50[1]	9	Zoölogy 50	7
II.	Botany 51	8	Entomology 77	12
	Chemistry 52[1]	12	Entomology 90	7
	Entomology 55	8	Pomology 79[1]	7
	Entomology 56	6	Zoölogy 51	7
	French or German 51[1]	9		
III.	Entomology 65	8	Entomology 78	9
	Entomology 75	8	Geology 52	10
	Chemistry 53[1]	12	Horticulture 51[1]	10
	French or German 52[1]	9	Pomology 78[1]	8
			Zoölogy 52	7

[1] Suggested, but not required.

Microbiology. (Major.)

Professor Charles E. Marshall, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Microbiology	50 **I.**	
or		10
Microbiology	50 **II.**	
or		
Microbiology	50 **III.**	
Microbiology	51 **II.**	10
or		
Microbiology	51 **III.**	
Microbiology	52 **III.**	10
Microbiology	60 **I.**	9
Microbiology	61 **II.**	9
Microbiology	62 **III.**	9
Microbiology	81 **I.**	
or		
Microbiology	82 **I.**	10
or		
Microbiology	83 **III.**	
Microbiology	80 **II.**	
or		
Microbiology	75 **II.**	10
Microbiology	76 **III.**	10
		87

Term.	Junior.	Credit.	Senior.	Credit.
I.	Microbiology 50	10	Microbiology 60	9
	Microbiology 60	9	Microbiology 81	10
			Microbiology 82	10
II.	Microbiology 50	10	Microbiology 61	9
	Microbiology 51	10	Microbiology 75	10
	Microbiology 61	9	Microbiology 80	10
III.	Microbiology 50	10	Microbiology 62	9
	Microbiology 51	10	Microbiology 76	10
	Microbiology 52	10	Microbiology 83	10
	Microbiology 62	9		

Agricultural Economics. (Major.)

Professor Alexander E. Cance, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Economics	50 **I.**	12
Agricultural Economics	52 **II.**	12
Agricultural Economics	53 **III.**	12
Agricultural Economics	75 **II.**	12
Agricultural Economics	76 **II.**	12
Agricultural Economics	77 **I.**	12
Agricultural Economics	78 **III.**	9
Agricultural Economics	79 **I.**	12
Agricultural Economics	87 **III.**	9
Agricultural Education	55 **I.**	10
Economic Sociology	51 **II.**	12
Economic Sociology	52 **III.**	12
English	65 **I.**	9
Rural Sociology [1]	51 **II.**	9
Rural Sociology [1]	52 **III.**	9
		163 [2]

Term.	Junior.	Credit.	Senior.	Credit.
I.	Agricultural Economics 50	12	Agricultural Economics 77	12
	Agricultural Education 55	10	Agricultural Economics 79	12
	English 65	9		
II.	Agricultural Economics 52	12	Agricultural Economics 75	12
	Economic Sociology 51	12	Agricultural Economics 76	12
	Rural Sociology 51 [1]	9		
III.	Agricultural Economics 53	12	Agricultural Economics 78	9
	Economic Sociology 52	12	Agricultural Economics 87	9
	Rural Sociology 52 [1]	9		

[1] Suggested, but not required.

[2] Only 145 credit-hours required.

Agricultural Education. (Major.)

Professor Winthrop S. Welles, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Education	51 **I.**	10
or		
Agricultural Education	51 **II.**	10
Agricultural Education	52 **III.**	12
Agricultural Education	55 **I.**	10
or		
Agricultural Education	55 **II.**	10
Agricultural Education	56 **II.**	10
or		
Agricultural Education	56 **III.**	10
Agricultural Education	75 **II.**	6
Agricultural Education	76 **I.**	10
or		
Agricultural Education	76 **III.**	10
Agricultural Education	77 **III.**	6
Agricultural Education	80 **I.**	3–11
or		
Agricultural Education	80 **II.**	3–11
or		
Agricultural Education	80 **III.**	3–11
Agricultural Education	81 **III.**	3–5
Agricultural Education	83 **III.**	3–5
Agricultural Education	85 **I.**	6
		79–91

Term.	Junior.	Credit.	Senior.	Credit.
I.	Agricultural Economics 50	12	Agricultural Education 76	10
	Agricultural Education 55	10	Agricultural Education 80	3–11
	English 65	9		
II.	Agricultural Economics 52	12	Agricultural Education 75	6
	Agricultural Education 51	10	Agricultural Education 80	3–11
	Economic Sociology 51	12		
III.	Agricultural Economics 53	12	Agricultural Education 77	6
	Agricultural Education 56	10	Agricultural Education 80	3–11
	Rural Sociology 52	9		

Courses indicated for juniors and seniors are planned for students preparing to teach agriculture.

Advised. — (*a*) For general teaching program 51, 55, 56, 75 and 80 or their equivalents. (*b*) For extension teaching 51, 55, 76, 77 and 80 or their equivalents. (*c*) For special cases consult the department.

Rural Sociology. (Major.)

Professor —— ——, *Adviser.*

[The heavy-faced type indicates the term in which the course is given.]

Course.	Number.	Credit.
Agricultural Economics	50 **I.**	12
Agricultural Economics	52 **II.**	12
Agricultural Economics	53 **III.**	12
Agricultural Economics	75 **II.**	12
Economics and Sociology	50 **I.**	15
Economics and Sociology	51 **II.**	12
Economics and Sociology	52 **III.**	12
Economics and Sociology	75 **I.**	15
Rural Sociology	50 **I.**	9
Rural Sociology	51 **II.**	9
Rural Sociology	52 **III.**	9
Rural Sociology	77 **II.**	9
Rural Sociology	79 **I.**	3–9
Rural Sociology	80 **II.**	3–9
Rural Sociology	81 **III.**	3–9
		147–165[1]

Term.	Junior.	Credit.	Senior.	Credit.
I.	Economics Sociology 50	15	Agricultural Economics 50	12
	Rural Sociology 50	9	Economic Sociology 75	15
			Rural Sociology 79	3–9
II.	Economic Sociology 51	12	Agricultural Economics 52	12
	Rural Sociology 51	9	Agricultural Economics 75	12
			Rural Sociology 77	9
			Rural Sociology 80	3–9
III.	Economic Sociology 52	12	Agricultural Economics 53	12
	Rural Sociology 52	9	Rural Sociology 81	3–9

[1] Only 150 credit-hours required.

Description of Courses.

DIVISION OF AGRICULTURE.

Professor Foord.

[Heavy-faced Roman numerals indicate the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

Agriculture.

1. **I.** 2. **II.** 3. **III.** Agriculture. — Required course for all freshmen. A survey course, tracing the development of man as influenced by agriculture. It considers those problems which our complicated, present-day civilization looks to agriculture to solve, — problems practical, scientific, commercial, sociological. The object of the course is to give to students the agricultural concept, and an appreciation of the close relationship of all lines of human activity to the great problems of agriculture.

1 lecture, 2 quiz hours, 2 study hours, credit, 5.
Assistant Professor Lanphear.

26. **II.** Agricultural Opportunities for Women. — For sophomore women. Designed to show the woman who is interested in agriculture what opportunities there are for her in that field, and how she may best take advantage of them. The types of agricultural work for which women are best adapted are discussed. A study is made of some of the special problems which confront the woman farmer, and her best ways of solving them.

2 class hours, 1 study hour. Credit, 3.
Miss Hamlin.

Agronomy.

Professor Beaumont, Assistant Professor Michels, Assistant Professor Lanphear, Mr. Thayer, Mr. Jones.

The courses in agronomy are designed to present the fundamental knowledge concerning the soil and the principal products of the field. The basic course in soils is required of students majoring in the agriculture, horticulture, and rural social science divisions. The electives are designed to meet the needs of those specializing in soils and field crops and other specialized fields including both pure and applied science.

The laboratories for soils and fertilizers include one for elementary work, supplied with locker equipment for 200 students, and one for advanced work, accommodating 80 students. These laboratories are equipped with steam and electric ovens, balances, centrifuge, microscopes and other apparatus necessary for a study of soils and fertilizers. Storerooms, stock rooms, and balance rooms are conveniently near the laboratories. There is also a workroom attached, equipped with power machinery for grinding soils, fodders and the like.

The crops' laboratories include one for seed study, with lockers for 50 students, and a laboratory for the study of cereals, forage crops, roots, etc., with lockers for 64 students. The equipment of these laboratories includes steam ovens, constant temperature electric ovens, ovens for seed germination, Brown-Duval moisture apparatus, balances, microscopes, and collections of seeds, grasses, tubers, weeds, etc. A balance room, root cellar and two storerooms, one of which is mouse-proof, are also used for crop work.

A modern steam-heated greenhouse 25 by 35 feet, used for work in soils and crops, is a valuable part of the equipment. Near the greenhouse is a crop garden on which different varieties of corn, grasses, clovers, etc., are grown for demonstration purposes, and as a source of material for class work. In addition, the general college farm of 250 acres is used for field study in soils and crops, and as a source of material.

Required Courses.

25. I. AGRONOMY. — For sophomores. An introductory course designed to acquaint the student with the most important field crops and their production.
2 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 9.
Assistant Professor MICHELS and the DEPARTMENT.

27. III. SOILS AND FERTILIZERS. — For sophomores. A study of soils and their properties, soil management, methods of soil improvement and maintenance of fertility, including the use of farm manures, commercial fertilizers and soil amendments.
4 class hours. 1 2-hour laboratory period, 3 study hours, credit, 9.
Professor BEAUMONT and the DEPARTMENT.
Prerequisite, Freshman-required Chemistry.

Elective Courses.

50. I. FIELD AND FORAGE CROPS. — For juniors; seniors may elect. History, classification and production of corn and of those grasses, legumes, root and tuber crops suited to New England conditions. Crops of less importance in New England are briefly considered. The work includes lecture, laboratory and field study.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
Assistant Professor MICHELS.
Prerequisites, Agronomy 25 and 27, Botany 3.

51. III. ADVANCED FIELD CROPS (1924–25). — For juniors; seniors may elect. Study of the cereals and other field crops not taken up or only briefly considered in Course 50. General problems of crop production are also considered, and the work is not entirely confined to New England conditions. The laboratory work includes a study of the cereals, the quality of seeds, grains and crop products, crop problems and field work with such crops as are available. Given in alternate years.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Assistant Professor MICHELS.
Prerequisite, Agronomy 50.

75. I. ADVANCED SOILS. — For seniors; juniors may elect. A continuation of studies begun in Agronomy 27 with special emphasis placed on soil classification and adaptability and recent advances in soil science. The field work consists of a detailed study of soil texture and other properties affecting crop adaptability and soil management; accompanied by a laboratory study of the physical properties of the soils sampled.
2 class hours. 2 study hours, 1 4-hour and 1 2-hour laboratory period, credit, 10.
Professor BEAUMONT.
Prerequisite, Agronomy 27.

77. II. MANURES AND FERTILIZERS. — For seniors. An advanced course, giving a general discussion of the different theories which have been held relative to the functions and importance of manures and fertilizers, and leading up to the views at present accepted. Considerable attention is devoted to consideration of the experimental work which has been done, and which is now in progress. The

laboratory work consists of a study of fertilizers, fertilizer mixtures, limes and culture work.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
Professor Beaumont and the Department.
Prerequisite, Agronomy 27. Advised, Chemistry 61.

78. **II.** Breeding of Field Crops (1924–25). — For seniors. Deals with the improvement, by selection and breeding, of the crops studied in Course 50. Given in alternate years.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Assistant Professor Michels.
Prerequisite, Agronomy 50.

Animal Husbandry.

Professor ——, Assistant Professor Rice, Assistant Professor Glatfelter, Mr. Thayer.

It is the purpose of this department to present comprehensive information on the subject of animal husbandry. The first courses are studies of the breeds, types and market classes of live stock. These are followed by courses in judging, breeding and management.

The department is equipped with an excellent laboratory, Grinnell Arena, which has a seating capacity of 180. The equipment for classroom instruction includes upwards of 125 head of dairy cattle which are superior representatives of Jersey, Guernsey, Ayrshire and Holstein breeds; considerable numbers of Berkshire and Chester White pigs; pure-bred Percherons; and several work teams of various types. The department has a collection of plaster of Paris models of individuals of foreign and domestic breeds of horses, cattle, sheep and swine; and a set of over 250 lantern slides portraying the leading prize-winning producing and breeding animals of the principal breeds of horses, cattle, sheep and swine. There is also a collection of the different foodstuffs available for the use of New England farmers. All this equipment is being added to from time to time as funds are available.

Required Courses.

25. **I.** Livestock Judging and Market Classes of Farm Animals. — A study of the principles governing the selection of animals for market, feed lot, breeding, milk production and work, including the use of the score card and the comparative judging of the various types of live stock. Text book, Vaughn's "Types and Market Classes of Farm Animals."
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Mr. Thayer.

26. **II.** Types and Breeds of Livestock. — A course covering the origin, history, development and characteristics of the different breeds of horses and sheep. Text book, Plumb's "Types and Breeds of Farm Animals."
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Mr. Thayer.
Prerequisite, Animal Husbandry 25.

29. **I.** General Animal Husbandry. — For students majoring in Rural Social Science. A general course to include work in the types, breeds, feeding, breeding and judging of farm animals.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Mr. Thayer.

Elective Courses.

50. **I.** Feeds and Feeding. — For juniors. A study of the principles of animal nutrition; of the composition and qualities of feeding materials. Text book, Henry's "Feeds and Feeding."
3 class hours, 4 study hours. Credit, 7.
Assistant Professor Rice.
Prerequisite, Animal Husbandry, 25 and 26.

51. **II.** Feeds and Feeding. — For juniors. A study of feeding practice as related to all farm animals. Considerable work will be given in the formulating of rations.
3 class hours, 4 study hours. Credit, 7.
Assistant Professor Rice.
Prerequisite, Animal Husbandry 50.

52. **III.** Advanced Stock Judging. — For juniors; seniors may elect. Designed to equip students in the judging of classes of different types of live stock; to strengthen them in the selection of superior sires; and equip them for stock judging at fairs. Visits are made to the best herds for the various breeds of stock in the State. Judging teams to represent the college will be selected from this class.
1 2-hour and 1 8-hour laboratory period, credit, 7.
Assistant Professor Rice.
Prerequisites, Animal Husbandry 25 and 26.

53. **III.** Principles of Breeding. — For juniors; seniors may elect. Designed to familiarize students with the problems that are involved in animal improvement; to acquaint them with the facts which are already established; to scrutinize prevailing theories; and to indicate the lines and methods of further work. Some of the subjects studied are: variations, their causes and heritability; DeVrie's theory of mutations; the inheritance of acquired characters; the pure line; Mendelian law; the making of new types; the determination of sex; applications to human heredity. A few periods at the end of the course are devoted especially to the application of principles in live-stock improvement. Supplementary reading.
5 class hours, 5 study hours. Credit, 10.
Assistant Professor Rice.
Prerequisites, Animal Husbandry 25, 26, Zoölogy 26.

75. **I.** Beef and Swine Production. — A study of the leading breeds of beef cattle and swine, together with the work of some of the most successful breeders. Considerable time will be given also to the production of commercial beef and pork. In this course such live-stock management problems as apply to beef cattle and swine will be included.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Assistant Professor Rice.
Prerequisites, Animal Husbandry 51, 52, and 53.

76. **II.** Horse and Sheep Production. — A study of the production of these animals planned in the same manner as that of the previous course.
2 lectures. 1 2-hour laboratory period, 3 study hours, credit, 7.
Assistant Professor Glatfelter.
Prerequisites, Animal Husbandry 51, 52 and 53.

77. **III.** Dairy Cattle and Milk Production. — A study of the leading breeds of dairy cattle, the most successful breeders and famous breeding animals, advance registry testing and feeding for production, sales methods and advertising.
2 lectures. 1 2-hour laboratory period, 3 study hours, credit, 7.
Mr. Thayer.
Prerequisites, Animal Husbandry 51, 52 and 53.

81. **II.** Dairy and Animal Husbandry. — Seminar for seniors majoring in dairying and animal husbandry.
1 class hour, 1 study hour. Credit, 2.
Departments of Dairying and Animal Husbandry.

82. **III.** A continuation of Course 81. Credit, 2.
1 class hour, 1 study hour.
Departments of Dairying and Animal Husbandry.

Dairying.

Professor Judkins, Assistant Professor Yaxis, Mr. Pendleton, Mr. Smith.

The dairy manufactures building is new, well lighted and of sanitary construction. It is designed and equipped especially for teaching dairy manufactures. The equipment includes all kinds of machinery that are considered essential to the proper handling of milk and the making of cream, butter, ice cream and soft cheeses.

Course 50 is for students who desire a general idea of dairy work and manufacturing processes. Part of the courses are arranged to give instruction in general dairy work as associated with Massachusetts agriculture; part are arranged to give to a smaller group of students more complete work in dairy manufactures. Those majoring in dairy manufactures should have at least one summer's experience in a commercial plant before graduation.

50. I. General Dairying. — For juniors; seniors may elect. A general course, prerequisite to all other dairy courses and for those who wish to take only one course in dairying to get a general knowledge of the subject. The work covers briefly a study of milk, its secretion, composition and various tests applied thereto; proper methods of handling milk and cream; the use of separators; elementary butter making, cheese making and ice cream making.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
Professor Judkins.

51. II. Judging Dairy Products. — For juniors. The judging of milk, cheese, butter and ice cream according to standard methods. A team is chosen from this class to represent the college in the dairy products judging contests held at the Eastern States Exposition and at the National Dairy Show.
2 2-hour laboratory periods, credit, 4.
Professor Judkins.

Prerequisite, Dairy 50.

52. III. Market Milk. — For juniors; seniors may elect. A study of the various phases of the market milk industry, sanitary production; transportation; marketing; handling in the city plant; delivery systems; milk and its relation to the public health; inspection; milk laws; food value and advertising. Some milk plants will be visited.
3 class hours. 1 4-hour laboratory period, 3 study hours, credit, 10.
Professor Judkins and Mr. Smith.

Prerequisite, Dairy 50.

75. I. Milk Products. — For seniors. The manufacture of milk products other than butter and ice cream, including cheddar cheese, soft and fancy cheese, condensed and powdered milk, casein, commercial buttermilk, etc. Laboratory exercise largely in cheese making and commercial buttermilk manufacture.
1 class hour. 1 4-hour laboratory period, credit, 5.
Assistant Professor Yaxis.

Prerequisite, Dairy 50.

76. I. Advanced Testing. — For seniors; juniors may elect. Work covers moisture and fat testing for all dairy products; the casein test; salt test for butter; acid tests; work with the Mojonnier apparatus and many other applied chemical tests used in dairy manufacture work.
2 4-hour laboratory periods, 1 study hour, credit, 9.
Mr. Pendleton.

Prerequisite, Dairy 50.

Elective Courses.

77. **II.** Butter Making. — For seniors; juniors may elect. A study of separators and cream separation; handling milk and cream for butter making; preparation of starters, and ripening cream; churning; markets and their requirements; marketing, scoring and judging butter; management; butter making machinery and care thereof; problems.
2 class hours. 2 3-hour laboratory periods, 2 study hours, credit, 10.
Assistant Professor Yaxis.
Prerequisite, Dairying 50.

78. **III.** Ice Cream Making. — For seniors; juniors may elect. A study of the principles and practice of ice cream making. Laboratory equipment is modern and the laboratory instruction will cover commercial practices. Some ice cream plants will be visited.
2 class hours. 2 3-hour laboratory periods, 2 study hours, credit, 10.
Mr. Pendleton.
Prerequisite, Dairying 50.

Farm Management.

Professor Foord, Assistant Professor Abell.

The purpose of the courses in this department is to present various considerations of farming as a business. This involves a knowledge of the cost of production and the profit from the different enterprises such as dairy, poultry or orchard; a study of the enterprises, and the relative amounts of each that will give the best use of labor and equipment on the farm under consideration.

The college farm of 250 acres is under the general supervision of the Department of Farm Management, and furnishes demonstration material. It includes improved land, pasture land and a farm woodlot. The improved land illustrates the value of good culture and the best known methods for the maintenance of fertility. The farm is equipped with suitable buildings and good machinery for the work carried on, of which the production of certified milk is an important branch. Several good farms in the vicinity, illustrating types of both special and general agriculture, may be inspected and studied. The offices of the department are in Stockbridge Hall.

Elective Courses.

51. **II.** Farm Accounts and Cost Accounting. — For seniors; juniors may elect. A study of farm inventories, single-enterprise accounts, complete farm accounts and farm records. Special emphasis is given to the interpretation of results and their application in the organization and management of the farm.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
Professor Foord.

76. **I.** Farm Management. — For seniors; juniors may elect. A study of farming as a business; regions and types of farming; the general principles of farm management and the influence of size, production, live stock and crop farming on the farmer's labor income; arrangement of fields and buildings; use of land, capital and labor; choosing and buying a farm.
2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Professor Foord.
Prerequisites, Agronomy 50, Animal Husbandry 25 and 26, and some farm experience.

77. **III.** Farm Management. — For seniors; juniors may elect. A further and more specific study of the principles and practices as outlined in Course 76, with reference to their application to different regions of the United States and

especially to New England. Trips to successful farms are a required part of the course.
1 class hour. 1 4-hour laboratory period, 2 study hours, credit, 7.
Professors FOORD and ABELL.
Prerequisites, Farm Management 51 and 76.

78. **II.** SEMINAR. — For seniors majoring in general agriculture; others by arrangement.
1 class hour. 1 study hour, credit, 2.
Professors FOORD and ABELL.

79. **III.** SEMINAR. — For seniors majoring in general agriculture; others by arrangement.
1 class hour. 1 study hour, credit, 2.
Professors FOORD and ABELL.

81. **III.** FARMING IN THE UNITED STATES. — For seniors. A study of the agricultural regions of the United States and the different types and methods of farming carried on in each. The economic reasons for the establishment and maintenance of each type will be considered.
2 2-hour laboratory periods, 2 study hours, credit, 6.
The DEPARTMENT.
Prerequisite, Farm Management 76.

Poultry Husbandry.

Professor GRAHAM, Professor SANCTUARY,[1] Assistant Professor BANTA, Miss PULLEY.

The introductory courses (50, 51, 52) give a knowledge of the general routine of elementary poultry keeping. The advanced studies prepare men for the successful operation of poultry plants, either as owners or managers. Graduate work, preparation for further teaching, extension or investigation.

The poultry plant consists of 8 acres of land sloping gently to the west. The buildings consist of three incubator cellars equipped with a number of lamp incubators and two mammoth machines with a total capacity of 9,000 eggs; a pipe brooder house (open pipe system) and 40 colony brooder houses which give a brooding capacity for 7,000 chicks, the equipment for these houses including a large variety of coal-stove brooders and kerosene hovers; a long laying house 14 by 180 feet, which accommodates 500 layers, furnishing facilities for student work in pen management, utility and fancy judging, etc.; and a laboratory 14 by 80, for killing, picking, drawing, trussing, packing, crate fattening and cramming. The fattening equipment consists of a modern sanitary all-steel battery with 16 compartments and 10 wooden crates, accommodating, altogether, 350 birds. There are also a storage building, 28 to 64 feet, for root cellar, poultry carpentry, poultry mechanics, feed room and storage; an experimental breeding house, 18 by 60; a combination laying, testing and breeding house, 18 by 72, for experimental purposes; a model laying house, 18 by 30, for 100 hens, and a house 20 by 40, for 200 hens. The six old experiment-station houses, each 12 by 18 feet, are used as special mating and overflow pens. The total capacity for laying hens is 1,600. A manure shed 14 by 18 feet; an oil and tool house 10 by 12; an incinerator 10 by 10; and two backyard model poultry houses 8 by 10 and 8 by 8 give a total of 76 buildings, not including a pheasant run, 16 roosting sheds 10 by 10, and numerous small coops for natural incubation and brooding.

Elective Courses.

50. **I.** JUDGING AND CULLING. — For juniors; seniors may elect. A study of the origin and evolution of our standard breeds and varieties. Judging for production quality, using trap-nested birds; culling the flock; judging exhibition

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[1] Absent on leave.

quality by score card and comparison. Several farms will be visited, also several of the leading Connecticut Valley Poultry Shows. Poultry Judging Teams competing in the Intercollegiate Contest at Madison Square Garden are trained in this course.
2 class hours. 2 3-hour laboratory periods, 2 study hours, credit, 10.
Assistant Professor BANTA.

51. **II.** POULTRY FEEDS AND FEEDING. — For juniors; seniors may elect. A study of the principles and practices of poultry nutrition and their relationship to other poultry problems. An important part of the work will be the practical management of a pen of birds for a period of weeks, including observations and detailed record keeping.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
Assistant Professor BANTA.

52. **III.** INCUBATION, BROODING AND GROWING. — For juniors; seniors may elect. A study of the fundamental principles of incubation and rearing chicks; also of modern equipment, including small and mammoth incubators and various types of brooding apparatus.
2 class hours. 3 2-hour laboratory periods, 2 study hours, credit, 10.
Professor SANCTUARY and Miss PULLEY.

75. **I.** POULTRY HOUSING AND SANITATION. — For seniors. A consideration of the biological and economic principles fundamental in the efficient designing, practical construction and equipping poultry farm buildings; also of external parasites and the insecticidal agents for their control.
3 class hours. 3 study hours, credit, 6.
Assistant Professor BANTA.

76. **I.** MARKET POULTRY AND POULTRY PRODUCTS. — For seniors. A study of the market classes of poultry, eggs and feathers, the requirements of different markets, methods of marketing, the cold storage of poultry and eggs. Preserving eggs, judging and scoring of live and dressed market poultry and market eggs are important features. Students are required to fatten pens of chickens by different methods and rations, keeping accurate data of the gains in weight and quality, also the costs of feed and labor, and resultant profit or loss. The annual market poultry show is staged under the direction of members of this class.
2 class hours. 2 2-hour laboratory periods, 2 study hours, credit, 8.
Professor GRAHAM and Miss PULLEY.

77. **II.** POULTRY BREEDING. — For seniors. A study of the principles of breeding and their application to poultry. Practice work in record keeping, pedigree hatching, stud and flock mating will be required as the season permits.
4 class hours. 1 2-hour laboratory period, 4 study hours, credit, 10.
Professor SANCTUARY.

78. **III.** FARM POULTRY. — For seniors; juniors may elect. For those students who desire a general knowledge of poultry husbandry but who cannot devote more than one term to the subject; it is not intended for students specializing in poultry, and such students are admitted only by special permission. Emphasis is placed on the farm flock and its economic management. Utility classification, housing, culling, feeding, hatching, rearing, production, marketing and disease control receive special consideration.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
Assistant Professor BANTA.

79. **III.** POULTRY FARM ORGANIZATION. — For seniors. A study of the organization of the poultry farm for greatest efficiency. The layout of fields and

buildings, crop rotations, records, accounts and advertising will receive consideration. One or more trips will be made to representative successful poultry farms.

3 class hours. 1 2-hour laboratory period, 3 study hours, credit, 8.
Prerequisite, Poultry 77. Professor Graham.

Rural Engineering.

Professor Gunness, Assistant Professor Strahan, Mr. Pushee, Mr. Newlon.

The courses in rural engineering are planned to give a working knowledge of those phases of engineering which apply directly to the farm. It is expected that the student will acquire a clear understanding of modern farm practice as it relates to permanent improvements of the farm and the farmstead, and in the selection and use of farm equipment.

This department has an office and the use of a lecture room in Stockbridge Hall. The work on farm structures is given in the large drawing room in the same building. This room is fitted with thirty drawing tables. Models and blue prints are available for the study of farm buildings. A set of post molds and a machine for making cement tile afford opportunity for practical work with cement.

The rural engineering shop is a one-story structure 68 by 126 feet. The carpenter shop in this building is fitted with benches fully equipped with tools for each student. The general repair shop is equipped with forges, benches, a drill press and grinders. The laboratory for farm machinery and farm motors is equipped with a complete line of field machines, gasoline engines, tractors and pumps. A complete assortment of engine accessories, consisting of carburetors, magnetos, etc., is available for thorough instruction in gas engines. A small dynamo and switchboard are used in the study of farm-lighting systems. The work on the small field machines is given in the basement of Stockbridge Hall, and the work on steam engines and steam heating is given in Flint Laboratory.

Required Courses.

27. **III.** Mechanical Drawing. — For sophomores; juniors and seniors may elect. Exercises are given in freehand lettering, geometric construction, orthographic projection and isometric drawing. Practice is given in inking, tracing, and blueprinting.

2 2-hour laboratory periods, credit, 4.
Assistant Professor Strahan.

30. **III.** Shop Practice. — For sophomores; juniors and seniors may elect. Practice is given in the use of carpentry tools by exercises in bench work, repair of farm equipment and farm building construction. Exercises in forge work, pipe fitting, soldering, babbitting and fitting bearings, lining up shafting, lacing belts, and splicing rope. Practice in the use of machinists' tools, such as file, cold chisel, drill press, lathe, taps and dies.

4 2-hour laboratory periods, credit, 8.
Mr. Pushee and Mr. Newlon.

Elective Courses.

75. **I.** Farm Structures. — For seniors; juniors may elect. A study of the strength and durability of concrete, wood, stone, and clay products, and of the mechanical principles underlying their use in farm construction. The design of various farm buildings, such as the general purpose barn, dairy stable, hog house, sheep barn, milk house, etc. In the drafting room, details of construction will be worked out, a study of the mechanics of simple roof trusses will be made, and a

complete design of some major farm building will be finished in all essential details. If time permits, blueprints of the finished design can be made.
2 class hours. 3 2-hour laboratory periods, 2 study hours, credit, 10.
Assistant Professor STRAHAN.

78. **II** and **III**. FARM MOTORS. — This course deals with the gasoline engine as used for stationary work, automobiles, and tractors. Instruction is given by means of lectures and textbooks, and by operating and repairing stationary engines, automobiles, and tractors. Special attention is given to overhauling and repairing.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
The DEPARTMENT.

79. **III**. DRAINAGE AND IRRIGATION ENGINEERING. — For seniors; juniors may elect. Covers the engineering phase of drainage and irrigation. The various systems are studied, and practice is given in the design of drainage and irrigation systems. Field work gives practice in surveying for drains, platting, locating drains, erecting batterboards and laying tile. Practice is given in assembling equipment for spray irrigation, and the flow of water through nozzles is studied by means of laboratory tests.
2 class hours. 2 3-hour laboratory periods, 2 study hours, credit, 10.
Assistant Professor STRAHAN.

81. **III**. DAIRY MECHANICS. — A study of dairy machinery, including steam boilers, engines, pumps, traps, refrigeration machinery, and heat-controlling devices. Practice is given in pipe fitting, packing valves, lacing belts, and similar repair jobs on the equipment used in dairy plants.
1 4-hour laboratory period, credit, 4.
Professor GUNNESS and Mr. NEWLON.

DIVISION OF HORTICULTURE.

Professor WAUGH.

[Heavy-faced Roman numerals indicate the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

Floriculture.

Professor THAYER, Assistant Professor MULLER.

The courses in floriculture are intended to present a general knowledge of all phases of greenhouse design, construction, heating and management, the culture of florists' crops (under glass and in the field), floral decoration and arrangement. The department aims to train students so that they may take up commerical floriculture (either in the growing or retail business) and the management of conservatories on private estates, in parks and cemeteries.

The department is especially well equipped for the teaching work, probably being supassed in no other agricultural college. French Hall, with its laboratories, classrooms and offices, furnishes excellent facilities for the purposes of instruction. The glass area of the department consists of approximately 20,000 square feet, divided as follows: French Hall range of 7,200 square feet, a durable, practical, commercial range composed of palm and fern, violet, carnation, rose and students' houses; the old Durfee range of 7,400 square feet, devoted to the growing of decorative, conservatory and bedding plants and chrysanthemums; one house of 3,200 square feet, suitable for propagating work and general plant culture; and approximately 2,200 square feet in cold frames and hotbeds.

In addition, the department has 2 acres of land used for the summer culture of carnations, violets, gladioli, dahlias, sweet peas, bedding plants, etc. This also includes a small garden of about 4,700 square feet devoted to the culture of annuals. A large collection of biennials and herbaceous perennials is maintained and is being

enlarged from year to year; at the present time the collection consists of several hundred species and varieties, and provides an excellent opportunity for the study of garden flowers.

Elective Courses.

50. **I.** Greenhouse Management. — For juniors; seniors may elect. Designed to familiarize students with the methods followed in the management of greenhouses and of greenhouse crops and the principles underlying the same; history and development of the floricultural industry; preparation of soils; fertilizers; potting; watering; ventilation; control of insects and diseases; methods of plant propagation; forcing of plants. At some time during the term the members of the class will be required to take a one-day trip to visit large commercial establishments. Lectures, assigned readings, reports and laboratory practice.
2 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 9.
Professor Thayer.

Prerequisite, Horticulture 25 and 26.

51. **II.** Greenhouse Management. — For juniors; seniors may elect. Continuation of Course 50. Several field trips, to study floricultural establishments in the vicinity, will be made during the laboratory periods.
2 class hours. 1 4-hour laboratory period, 3 study hours, credit, 9.
Professor Thayer.

52. **III.** Floral Arrangement. — A study of the principles underlying the arrangement and use of cut flowers and plants; funeral designs, basket and vase arrangement, table decorations, home, church and all interior decorations; a study of color as applied to such work. Lectures, assigned readings and reports. This course will be limited to ten students.
2 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 9.
Professor Thayer.

53. **I.** Greenhouse Construction and Heating. — For juniors; seniors may elect. The location, types, arrangement, construction, cost, equipment, heating and ventilating of greenhouse structures; the drawing of plans and study of specifications for commercial houses and conservatory ranges. Such practical work as glazing and the construction of concrete benches and cold frames is included as facilities allow. Lectures, assigned readings and problems.
3 class hours. 1 2-hour laboratory period, 3 study hours, credit, 8.
Professor Thayer.

55. **III.** Garden Flowers and Bedding Plants. — For juniors and seniors. A study of the annuals, biennials, herbaceous perennials, bulbs, bedding plants and roses that are valuable for use in floricultural or landscape gardening work. Methods of propagation, culture and uses of the various plants are considered; identification of material. Lectures, assigned readings and reports.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Professors Thayer and Muller.

75. **I.** Commercial Floriculture. — For seniors. A detailed study of the important commercial cut flower crops and potted plants. Visits will be made to commercial establishments during the term. The lectures are supplemented with textbooks and assigned readings.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Assistant Professor Muller.

Prerequisite, Floriculture 51.

76. **II.** Commercial Floriculture. — For seniors. As stated under Course 75.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Assistant Professor Muller.

Prerequisite, Floriculture 75.

77. **III.** Commercial Floriculture. — For seniors. As stated under Course 75.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Assistant Professor Muller.
Prerequisite, Floriculture 76.

79. **II.** Conservatory Plants. — For seniors. A study of the foliage and flowering plants used in conservatory work; methods of propagation, culture, use and arrangement; identification of plants. Lectures, assigned readings and reports.
2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Professor Thayer.
Prerequisite, Floriculture 51.

80. **III.** Seminar. — For seniors majoring in floriculture. Advanced study of subjects pertaining to some phase of floriculture. All students are assigned specific problems and pursue study in these problems by reading and research; the results of this study must be presented in the form of a thesis. Seminars are conducted weekly.
1 class hour. 2 to 4 laboratory hours, 2 to 4 study hours, not to exceed 9 credits.
Professor Thayer.

Forestry.

Professor Grose.

The forestry courses are intended primarily for prospective owners or managers of farm woodlots, and the field work is focused on typical New England problems. These courses are broad enough, however, to furnish valuable preparation for students planning to study forestry in graduate schools.

The department has an unusually complete equipment of the various instruments used in forest mensuration, forest mapping and engineering, timber estimating, log scaling, board measuring, etc.; and a large assortment of boards illustrative of the various commercial woods found in the lumber markets. The State Forest Nursery, comprising 6 acres of land and containing, approximately, 5,000,000 trees, transplants and seedlings, is on the college farm. Forests containing every variety of tree common to New England are within walking distance of the college. The college campus affords an arboretum containing a large number of trees not native to New England. The Mount Toby Demonstration Forest has an area of approximately 750 acres, and contains the various types of forest growth found throughout the State. It serves as a field laboratory in which students have the privilege of working out problems in silviculture, forest mensuration and management. Improvement cuttings, cuttings for utilization, and forest plantings are conducted by the department.

55. **I.** Woodlot Forestry: Estimating and Business Management. — For juniors and seniors. Topics: forest mapping; timber-cruising, determining rate of growth and possible cut; financial returns; forest taxation; our national timber supply, present and future.
1 2-hour and 1 4-hour laboratory period, 1 study hour, credit, 7.
Professor Grose.

56. **II.** Woodlot Forestry: Logging, Milling and Marketing. — For juniors and seniors. Topics: felling trees; sawing logs; hauling logs; the portable mill; the stationary mill; seasoning, measuring and shipping lumber; lumber grades and prices; legal forms; by-products of the woodlot; adaptability of species to uses; wood-using industries of Massachusetts.
2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Professor Grose.

57. **III.** Woodlot Forestry: Timber-raising. — For juniors and seniors. Topics: forest planting; weeding; release cuttings; pruning; thinning; salvage cutting; protection from insects, fungi, fire, etc.; final cutting methods for natural reproduction of the forest.

1 2-hour and 1 4-hour laboratory period, 1 study hour, credit, 7.
Professor Grose.

58. **III.** Woodlot Forestry: Brief Survey. — A condensation of Courses 55, 56 and 57 for those who have only one term to give to forestry.

2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Professor Grose.

Horticultural Manufactures.

Professor Chenoweth, Mr. Robertson.

The courses aim to give a practical knowledge of the problems connected with food preservation. Emphasis is placed upon the conservation of the cheaper grades of fruits and vegetables, to the end that the whole crop may be marketed at a profit and that wholesome food products may result from what would otherwise be lost. The social and economic values of this work are constantly emphasized.

The department occupies three laboratory rooms in Flint Laboratory, two in Fisher Laboratory, with offices in Wilder Hall and French Hall. The general equipment of the department, both for the use of students and for manufacturing purposes, may be grouped under the following heads: —

1. *Canning.* — A modern canning outfit, including both steam-pressure cookers and hot-water baths, hand and power can sealers, peeling and slicing machines, a string bean cutter, heat-penetration thermometers, electric incubator and a large assortment of all types of home canning equipment.
2. *Evaporation.* — Two small orchard evaporators, a tunnel drier, peeling machines, slicers and a general assortment of driers adapted to home evaporation.
3. *Fruit Juices, Butters, etc.* — A hand cider mill, a motor-driven hydraulic press, a steam-jacketed kettle, an apple-butter cooker, and cider and vinegar testing apparatus.

Elective Courses.

75. **I.** Horticultural Manufactures. — For seniors and graduate students. A practical course in food preservation dealing primarily with fruits and vegetables. The canning of fruits and vegetables as practiced in the home and in commercial canneries; evaporation of fruits and vegetables, the various types of equipment and methods of preparation of products. The manufacture of (*a*) fruit products, such as butters, jams, jellies, fruit juices, marmalades, preserves, vinegars, pastes, etc.; (*b*) vegetable products, as pickles, piccalilli, sauerkraut, soups, etc. Particular attention is given to study and use of all types of equipment suitable for use in the home or small factory, together with methods for testing a large variety of manufactured products. The emphasis is on canning, drying and study of equipment.

2 class hours. 3 2-hour laboratory periods, 4 study hours, credit, 12.
Professor Chenoweth.

76. **II.** Horticultural Manufactures. — For seniors and graduate students. A continuation of Course 75. The emphasis in this course is placed on the manufacturing and testing of fruit and vegetable products.

1 class hour. 2 2-hour laboratory periods, 3 study hours, credit, 8.
Professor Chenoweth.

Prerequisite, Horticultural Manufactures 75.

77. **III.** Horticultural Manufactures. — Continuation of courses 75 and 76, dealing primarily with maple products, the canning of meats and spring vege-

tables, and studies of special problems involved in establishing and operating home and farm factories.

2 2-hour laboratory periods, 2 study hours, credit, 6.
Professor CHENOWETH.

78. **III.** HORTICULTURAL MANUFACTURES. — For seniors and graduate students. A general course in food preservation, including lectures, readings and laboratory work in the canning and evaporation of fruits and vegetables, the manufacture of fruit and vegetable products. Special emphasis will be given to the conservation of the low grade fruits and vegetables in the home and in the farm factory.

2 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 9.
Professor CHENOWETH.

Horticulture.

Professor WAUGH, Professor THOMPSON, Assistant Professor ROGERS, Assistant Professor DICKINSON.

The general subject of horticulture divides naturally into subjects of pomology, floriculture, forestry, landscape gardening and vegetable gardening. A number of courses relate to more than one of these subjects, and are therefore grouped here under the general designation of horticulture.

Elective Courses (General).

50. **I.** PLANT MATERIALS. — For juniors; seniors may elect. Aims to make the student familiar with the character of the trees, shrubs and herbaceous perennials used in ornamental work, and with the methods of propagating them.

3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
Professor THOMPSON.

51. **III.** PLANT MATERIALS. — For juniors; seniors may elect. A continuation of Course 50, taking up the field use of trees, shrubs and herbaceous plants, their native habitats, soils and plant associations, with a view to supplying to students in landscape gardening and floriculture a knowledge of plant species. Frequent practicums and field excursions.

3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
Professor THOMPSON.

Prerequisite, Horticulture 50.

Landscape Gardening.

Professor WAUGH, Assistant Professor HARRISON, Assistant Professor FRENCH.

The purposes of the courses are: (1) To train men for the profession in all its branches. As a rule graduates should first enter the employ of established landscape architects, nurserymen or park superintendents, and after an apprenticeship of several years those who have the requisite technical and business ability may set up for themselves. (2) To train men for public-service work in national, State and municipal parks and forests. (3) To train men for country planning, this function being exercised through various public institutions and organizations. (4) To train teachers and extension workers in lines of landscape gardening and civic improvement. (5) To give a broad and liberal general education stressing the fundamental principles of art.

The department has large, well-lighted drafting rooms, with necessary equipment, such as planimeters, eidograph, pantograph, blue-printing outfit, etc.; and a complete outfit of surveying instruments, including transits, levels, plane tables, prismatic compasses, hand levels, etc. The college campus presents an unusually good collection of the plant materials used in landscape gardening.

Elective Courses.

50. **I.** Mapping and Topography. — For juniors. Reconnoissance surveys and mapping, with special reference to the methods used in landscape gardening; detailed study of selected designs of leading landscape gardeners; grade design, road design and field work. Must be followed by Course 51.

2 2-hour laboratory periods; 2 3-hour laboratory periods, credit, 10.
Assistant Professor Harrison.

Prerequisites, Mathematics 26 and 27, Drawing 25, 26 and 27.

51. **II.** Elements of Landscape Gardening. — For juniors. As stated under Course 50.

3 3-hour laboratory periods, 2 study hours, credit, 11.
Assistant Professor Harrison.

Prerequisite, Landscape Gardening 50.

52. **III.** General Design. — For juniors. Field notes; examination of completed works and those under construction; design of architectural details, planting plans, gardens, parks and private grounds; written reports on individual problems.

2 2-hour laboratory periods; 2 3-hour laboratory periods,
2 study hours, credit, 12.
Assistant Professor Harrison.

Prerequisites, Landscape Gardening 50 and 51, and either plant materials (Horticulture 50 and 51) or advanced mathematics.

75. **I.** Theory of Landscape Art. — For seniors and graduates. The general theory and applications of landscape study, including a brief history of the art.
3 class hours. 3 study hours, credit, 6.
Professor Waugh.

76. **I.** Civic Art. — For seniors. The principles and applications of modern civic art, including city planning, city improvement, village improvement and rural improvement, with special emphasis upon country planning. Must be followed by Course 77.

3 3-hour laboratory periods, 1 study hour, credit, 10.
Assistant Professor Rogers.

Prerequisite, Landscape Gardening 52.

77. **III.** Country Planning. — For seniors. As stated under Course 76.

3 3-hour laboratory periods, 3 study hours, credit, 12.
Professor Waugh.

Prerequisite, Landscape Gardening 76.

78. **I.** Architecture. — Alternating with Course 79; given in 1924–25. For juniors and seniors. The history of architectural development, the different historic types, with special reference to the underlying principles of construction and design and their relations to landscape design. Illustrated lectures, conferences, practice in designing.
3 class hours. 6 study hours, credit, 9.
Assistant Professor Harrison.

79. **I.** Construction and Maintenance. — Alternating with Course 78; given in 1925–26. For juniors and seniors. Detailed instruction in methods of construction and planting in carrying out plans, in organization, reporting, accounting, estimating, etc.; maintenance work in parks and on estates, its organization, management, cost, etc.
3 class hours. 6 study hours, credit, 9.
Assistant Professor Harrison.

80. **II.** Theory of Design. — For juniors. As stated under Course 52.
3 class hours. 9 study hours, credit, 12.
Professor Waugh.

Prerequisite, Landscape Gardening 52.

81. **II.** Estate Design.
3 3-hour laboratory periods, 3 study hours, credit, 12.
Assistant Professor Harrison.

82. **III.** Park Design.
3 3-hour laboratory periods, 3 study hours, credit, 12.
Assistant Professor Harrison.

Pomology.

Professor Sears, Professor Van Meter, Assistant Professor Drain, Mr. French, Mr. Raleigh.

The object of the course is to give a training which shall be thoroughly practical and yet scientific. This will fit the men to enter the field of practical fruit growing, or it will furnish an excellent foundation for further study.

The department has 50 acres in fruit plantations. The apple orchards comprise about 35 acres, and there are blocks of pears, peaches, plums and cherries. In small fruits there are plantings of strawberries, raspberries, blackberries, currants and gooseberries. There are three vineyards, with a total area of 5 acres, in which the leading varieties and the principal types of pruning and training are represented. In these plantations are 50 varieties of grapes, representing three native American species and many hybrids; 20 varieties of peaches; 20 varieties of pears; 25 of plums, including five species and many hybrids; and 100 varieties of apples.

The department has an excellent equipment of spraying and dusting machinery, including various styles and sizes of power sprayers, and many types of barrel pumps and smaller sprayers. There is also an excellent assortment of orchard tools, including plows, harrows, fertilizer sowers, etc.

Fisher Laboratory is one of the best planned and equipped packing and storage plants in the United States. It includes six refrigerated rooms; four storage rooms not refrigerated; one large laboratory room and one classroom, besides ample storage room for fruit packages and equipment. The equipment for the building itself includes four types of apple sizers; packing tables and box and barrel presses of various types, besides all kinds of packages and the smaller equipment necessary for thoroughly modern work in grading and packing fruit. The department is equipped with lockers and with pruning and other tools for the use of students in laboratory work, which is made a leading feature in all the courses in pomology.

Elective Courses.

50. **I.** Practical Pomology. — For juniors; seniors may elect. A study of the general principles of the growing of fruits, dealing with such questions as selection of site, soils, windbreaks, laying out plantations, choice of nursery stock, pruning, culture of orchards, orchard fertilizers, cropping orchards, etc. Lectures, supplemented with text and reference books; field and laboratory exercises.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Professor Sears and Mr. French.

Prerequisite, Horticulture 26.

51. **II.** Practical Pomology. — For juniors; seniors may elect. As stated under Course 50.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Professor Sears and Mr. French.

Prerequisite, Pomology 50.

52. **III.** Small Fruits. — For juniors; seniors may elect. A study of the growing of small fruits, including raspberries, blackberries, strawberries, currants, gooseberries and grapes, dealing with such questions as their propagation, selecting a site for the plantation, soils, fertilizers, pruning, etc.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Professor Sears and Mr. French.
Prerequisite, Pomology 51.

54. **II.** Systematic Pomology. — For juniors. A study of the varieties and nomenclature of the different fruits, with critical descriptions; special reference given to relationships and classification. Lectures, laboratory and field exercises.
1 class hour. 2 2-hour laboratory periods, 3 study hours, credit, 8.
Assistant Professor Drain.
Prerequisite, Pomology 50.

75. **I.** Systematic Pomology. — For seniors. As stated under Course 54.
1 class hour. 2 2-hour laboratory periods, 3 study hours, credit, 8.
Assistant Professor Drain.
Prerequisite, Pomology 54.

76. **II.** Orchard Management. — For seniors. Consideration will be given to the organization of a fruit farm to secure the most satisfactory distribution of income and of labor requirements. The costs of operations will be studied in connection with the keeping of orchard accounts and the estimation of supplies and equipment. The course will include a series of problems dealing with the application of principles learned in previous courses.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Professor Van Meter.
Prerequisite, Pomology 51.

77. **I.** Commercial Pomology. — For seniors. The picking, handling, storing and marketing of fruits, including a discussion of storage houses, fruit packages, methods of grading and packing. Especial emphasis is placed upon laboratory and field work, where the student is given actual practice in the picking and packing of all the principal fruits.
1 class hour. 2 2-hour laboratory periods, 3 study hours, credit, 8.
Mr. Raleigh.
Prerequisite, Pomology 51.

78. **III.** Spraying. — For seniors. A study of (*a*) spraying materials, their composition, manufacture and preparation for use; the desirable and objectionable qualities of each material, formulas used, cost, tests of purity. (*b*) Spraying machinery, including all the principal types of pumps, nozzles, hose and vehicles; their structure and care. (*c*) Orchard methods in the application of the various materials used, with the important considerations for spraying each fruit and for combating each orchard pest. This course is designed especially to familiarize the student with the practical details of actual spraying work in the orchard. Spray materials are prepared, spraying apparatus is examined and tested, old pumps are overhauled and repaired, and the actual spraying is done in the college orchards and small-fruit plantations.
1 class hour. 2 2-hour laboratory periods, 3 study hours, credit, 8.
Assistant Professor Drain.
Prerequisite, Pomology 76.

79. **II.** General Pomology. — For seniors; juniors may elect. Planned to meet the needs of students who cannot devote more than one term to the subject, but who want a general knowledge of fruit growing. Consists of lectures and laboratory exercises on such topics as choosing the locations, kinds and varieties

of fruits to grow, securing and setting the plants, care and cultivation, pruning, spraying, pests, harvesting and storing.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Assistant Professor Drain.

80. **I.** Seminar. — For seniors majoring in pomology. Advanced study of problems relating to the business of fruit growing. Each student is assigned a major and a minor problem in lines of work in which he is particularly interested. He pursues his studies both by reading and research, and the materials obtained will be worked into theses which are presented to the seminar for discussion. No lectures are given, but seminar meetings are held for one period each week.
1 class hour. 1 study hour, credit, 2.
The Department.

81. **II.** Seminar. — For seniors majoring in pomology. A continuation of Course 80. One seminar meeting each week.
1 class hour. 1 study hour, credit, 2.
The Department.

82. **III.** Seminar. — For seniors majoring in pomology. A continuation of Course 81. One seminar meeting each week.
1 class hour. 1 study hour, credit, 2.
The Department.

Vegetable Gardening.

Professor Waugh, ——— ———, Mr. Snyder.

The courses in Vegetable Gardening are designed for students who wish to enter commercial vegetable growing, the seed business, or professional work, such as teaching or experimental work. Each of these fields offer wide possibilities and the advancement of vegetable production will depend upon the number and quality of the men trained along these lines.

The department has ten acres of land, 3,800 sq. ft. of greenhouse space, and 150 hotbed sash, all of which are used to provide laboratory facilities. Part of this equipment is used for the non-commercial laboratory work, such as the students' gardens and the type and variety garden, while the remainder is devoted to commercial laboratory work.

In addition the department maintains at Waltham, Massachusetts, the Market Garden Field Station. Here the experimental and extension work of the department is carried on.

Elective Courses.

50. **III.** General Vegetable Gardening. — For juniors; seniors may elect. A general course for those students who desire a general knowledge of agriculture, but do not care to spend the time for extreme specialization. Designed to teach the fundamentals of vegetable growing so they may be applied (1) to the growing of vegetables commercially as a cash crop with other types of agriculture, (2) to the growing of vegetables in the home garden, (3) to agricultural teaching in secondary schools, and (4) to professional agricultural work other than teaching.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
———————.

52. **II.** Practical Vegetable Gardening. — For juniors; seniors may elect. Courses 52 and 53 are designed for those students who wish to obtain a knowledge of vegetable growing in order that they may apply this to the successful commercial production of vegetables, or to become fitted for professional work such as teaching and research work. The course begins with a consideration of vegetables as a food, the part they play in the food supply of the city, state, or nation, and Massachusetts' part in this type of food production, followed by a study of the fundamentals

of vegetable gardening. Deals with such questions as the selection of a location; soils, manures and fertilizers, green manures and cover crops; seeds and seeding; planting, tillage, irrigation; control of insects and diseases. Includes a detailed study of the cultural requirements of the common vegetable crops, and the principles of rotation and double cropping. Text and reference books. Laboratory and field exercises.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.

Prerequisites, Horticulture 26, Agronomy 75.

53. **III.** Practical Vegetable Gardening. — For juniors; seniors may elect. As stated under Course 52.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.

Prerequisite, Vegetable Gardening 52.

75. **I.** Types and Varieties. — For seniors. Includes the systematic study of types, varieties and strains of the leading vegetable crops; exhibiting and judging of vegetables; determination of quality in vegetables; seed growing, variety improvement, rogueing, seed harvesting, curing and storing.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.

Prerequisite, Vegetable Gardening 53 or 50.

76. **II.** Vegetable Forcing. — For seniors. A study of types, materials, construction, location, arrangement, capacity and cost of greenhouses for growing vegetables. A brief consideration of the heating plant, — the type, installation, piping and management; also the study of greenhouse vegetable crops and their production as practiced by commercial growers.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.

Prerequisite, Vegetable Gardening 53 or 50.

77. **III.** Commercial Vegetable Growing. — For seniors. A consideration of vegetable growing as a business. A study of this specialized type of farming, including places where developed, types, extent, economic importance, capitalization, equipment and other fundamental problems of commercial vegetable gardening. Students assist in the planning and operation of a typical market-gardening area. Visits are made to market-gardening and truck-gardening farms.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.

Prerequisite, Vegetable Gardening 53 or 50.

Drawing.

Required Courses.

25. **I.** Free-hand Drawing. — For sophomores; juniors and seniors may elect. Lettering; free-hand perspective; sketching from type models, leaves, flowers and trees, houses, etc.; laying flat and graded washes in water colors; water-color rendering of leaves, flowers and trees; conventional coloring and map rendering in water-colors; conventional signs and mapping in ink.
4 2-hour laboratory periods, credit, 8.

26. **II.** Mechanical Drawing. — For sophomores; juniors and seniors may elect. Inking exercises; geometric problems; projection; intersections; isometric;

shades and shadows; parallel; angular and oblique perspective; perspective drawing of buildings. Students should have preparation in plane and solid geometry.
3 2-hour laboratory periods, credit, 6.

27. **III.** Mechanical Drawing. — For sophomores; juniors and seniors may elect. As stated under Course 26.
4 2-hour laboratory periods, credit, 8.

Prerequisite, Drawing 26.

DIVISION OF SCIENCE.

Professor Fernald.

[Heavy-faced type indicates the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

Botany.

Professor Osmun, Assistant Professor Clark, Assistant Professor McLaughlin, Assistant Professor Torrey, Assistant Professor Davis.

A knowledge of the principles of plant life is fundamental in agricultural education. The required courses in botany are planned with this and the general educational value of the subject in view. Elective courses are of two types: (1) those which have for their chief aim the direct support of technical courses in agriculture and horticulture, and (2) those providing broader, more intensive training in the science. Courses in the second group may lead, when followed by postgraduate study, to specialization in the field. They also furnish excellent training for those specializing in other sciences and in scientific agriculture. In all undergraduate courses the relation of the science of botany to agriculture is emphasized.

The department occupies Clark Hall, a brick building 55 by 95 feet, two stories high, with basement and attic. The building has two lecture rooms with seating capacity of 154 and 72, respectively; one seminar and herbarium room; large laboratories for general and special work; and smaller rooms for advanced students. A glass-enclosed laboratory for plant physiology adjoins the main building and provides unusual facilities for the study of phenomena of plant life. In addition, a greenhouse 28 by 70 feet is connected with the building. This is for experimental work in plant pathology and physiology, and for growing plants needed for instruction. The experiment station laboratories devoted to botanical research are in this building.

The laboratories and lecture rooms are of modern construction, finely lighted, and equipped with compound and dissecting microscopes, microtomes, paraffin and drying ovens, physiological and other apparatus, and a large collection of charts. The herbarium contains about 20,000 sheets of seed plants and ferns, 1,200 sheets of liverworts and mosses, and 25,000 specimens of fungi. Facilities and equipment for the study of plant physiology and pathology are excelled in few other institutions.

Required Courses.

3. **III.** Introductory Botany. — For freshmen. Presents the seed plants as plastic organisms molded by their environment. Also introduces the student to methods of identifying and classifying plants.
2 class hours. 2 2-hour laboratory periods, 4 study hours, credit, 10.
Assistant Professor Torrey.

25. **I.** Introductory Botany. — For sophomores. The anatomy and physiology of the seed plants (Phanerogamia).
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
Assistant Professor Torrey.

Prerequisite, Botany 3.

26. **III.** Morphology and Taxonomy of the Lower Plants (Cryptogamia). — For sophomores. Systematic study of typical forms of bacteria, algæ, fungi, lichens, mosses, ferns. (Courses 3, 25 and 26 constitute a general elementary course in botany, and are required of all students who major in science.)
1 class hour. 3 2-hour laboratory periods, 2 study hours, credit, 9.
Professors Osmun and McLaughlin.
Prerequisite, Botany 25.

Elective Courses.

50. **I.** Diseases of Crops. — For juniors; seniors may elect. The lectures are general and are taken by all who elect the course, but in order to permit students to specialize on the diseases of crops most closely related to their majors or in which they are most interested, the course is divided for laboratory work into the following sections: (I) diseases of truck and field crops; (II) diseases of floricultural crops and ornamentals; (III) diseases of fruit crops; (IV) diseases of shade and forest trees. One, two or three laboratory sections may be taken.
1 class hour.
1, 2 or 3 2-hour laboratory periods, 3 study hours, credits, 6, 8 or 10.
Assistant Professor McLaughlin.
Prerequisites, Botany 3 and 25.

51. **II.** Diseases of Crops. — For juniors; seniors may elect. As stated under Course 50.
1 class hour.
1, 2 or 3 2-hour laboratory periods, 3 study hours, credits, 6, 8 or 10.
Assistant Professor McLaughlin.
Prerequisite, Botany 50.

52. **I.** Systematic Mycology. — For juniors; seniors may elect. Morphology and development of typical species representing the orders and families of fungi; practice in identification, collection and preservation of fungi; study of system of classification; collateral reading. A prerequisite of the senior course in plant pathology, but open to all.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
Assistant Professor Davis.
Prerequisite, Botany 26.

53. **II.** Systematic Mycology. — For juniors; seniors may elect. As stated under Course 52.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
Assistant Professor Davis.
Prerequisite, Botany 52.

54. **III.** Systematic Mycology. — For juniors; seniors may elect. As stated under Course 52.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
Assistant Professor Davis.
Prerequisite, Botany 53.

55. **III.** Plant Histology. — For juniors; seniors may elect. Comparative study of the tissues of plants; training in histological methods, including the use of precision microtomes, methods of killing, fixing, sectioning, staining and mounting; collateral reading and conferences. This course offers valuable training in preparation for further work in botany.
5 2-hour laboratory periods, credit, 10.
Assistant Professors McLaughlin, Torrey and Davis.
Prerequisite, Botany 3 and 25.

58. **I.** Systematic Botany of the Higher Plants (1924–25). — For juniors and seniors. An intensive study of gymnosperms and angiosperms. Lectures deal with the interrelations of the flowering plants and with their ecology, distribution and economic importance. Laboratory work consists of a critical study of types from the most important natural plant families. Particular emphasis is laid on the flora of Massachusetts. The department herbarium and greenhouses supply material of important tropical forms for study. Alternates with Course 61.
2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Assistant Professor Torrey.

59. **II.** Systematic Botany of the Higher Plants (1924–25). — For juniors and seniors. As stated under Course 58. Alternates with Course 62.
2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Assistant Professor Torrey.

60. **III.** Systematic Botany of the Higher Plants (1924–25). — For juniors and seniors. As stated under Course 58. Alternates with Course 63.
2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Assistant Professor Torrey.

61. **I.** The Comparative Anatomy of Green Plants (1925–26). — For juniors and seniors. In the lectures an intensive study is directed to the comparative anatomy of green plants from the evolutionary standpoint. Particular emphasis is laid upon the woody forms both living and extinct. Of the latter, the department is fortunate in possessing excellent sets of micro-preparations and lantern slides. Alternates with Course 58.
2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Assistant Professor Torrey.

62. **II.** The Comparative Anatomy of Green Plants (1925–26). — For juniors and seniors. As stated under Course 58. Alternates with Course 59.
2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Assistant Professor Torrey.

63. **III.** The Comparative Anatomy of Green Plants (1925–26). — For juniors and seniors. As stated under Course 58. Alternates with Course 60.
2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Assistant Professor Torrey.

75. **I.** Plant Pathology. — For seniors. Comprehensive study of diseases of plants; training in laboratory methods and technique, including culture work and artificial inoculation of hosts; miscellaneous diagnosis; study of literature and representative life histories of pathogens. Prepares for civil service, experiment station and college work.
1 class hour. 4 2-hour laboratory periods, 2 study hours, credit, 11.
Professors Osmun and Davis.

Prerequisite, Botany 54.

76. **II.** Plant Pathology. — For seniors. As stated under Course 75.
1 class hour. 4 2-hour laboratory periods, 2 study hours, credit, 11.
Professors Osmun and Davis.

Prerequisite, Botany 75.

77. **III.** Plant Pathology. — For seniors. As stated under Course 75.
1 class hour. 4 2-hour laboratory periods, 2 study hours, credit, 11.
Professors Osmun and Davis.

Prerequisite, Botany 76.

78. **I.** Plant Physiology. — For seniors. Study of the factors and conditions of (*a*) Plant Nutrition, including the taking up of water and mineral substances, the assimilation of carbon and nitrogen, and the release of energy due to the processes of dissimilation; (*b*) Plant Growth, including the influence of internal and external factors on growth, the development of reproductive and vegetative organs; (*c*) Plant Movements, including those due to the taking up of water, and those movements of both motile and fixed forms in response to external stimuli. Weekly conferences are held at which students report on assignments to original sources in the literature.
2 class hours. 3 2-hour laboratory periods, 2 study hours, credit, 10.
Assistant Professor Clark.
Prerequisites, Botany 26 and Chemistry 51.

79. **II.** Plant Physiology. — For seniors. As stated under Course 78.
2 class hours. 1 or 3 2-hour laboratory periods, 2 study hours, credit, 6 or 10.
Assistant Professor Clark.
Prerequisite, Botany 78 for the 10-credit course, Botany 25 for the 6-credit course.

80. **III.** Plant Physiology. — For seniors. As stated under Course 78.
2 class hours. 1 or 3 2-hour laboratory periods, 2 study hours, credit, 6 or 10.
Assistant Professor Clark.
Prerequisite, Botany 79.

General and Agricultural Chemistry.

Professor Lindsey, Professor Chamberlain, Professor Peters, Assistant Professor Serex, Mr. Phillips.

In teaching the courses in chemistry, emphasis is laid on both their educational and their vocational value. The courses in the freshman year deal with fundamental principles, and give the student such an understanding of the subject as will enable him to apply it in farm practice. The more advanced courses, including quantitative analysis and organic, physiological and physical chemistry, are for those who intend to become teachers and workers in the allied sciences, or who desire to follow agricultural chemistry as a vocation. Advanced training is given by means of postgraduate courses (see Graduate School).

Those completing the undergraduate courses are fitted for positions in the agricultural industries, — fertilizer, feed and insecticide manufacture, — as well as in other lines of industry, and in the State experiment stations, in commercial laboratories, and in high school teaching. Postgraduate students are prepared for positions as teachers in colleges, and for more advanced positions in industry and in the experiment stations.

The new Goessmann Chemistry Laboratory was opened for classes in September, 1924.

Required Courses.

The freshman work consists of two distinct parts: Courses 1 and 2 contain more hours and are for those who have had no chemistry in the secondary schools, and Courses 4 and 5 are for those who have presented chemistry for entrance. Both groups of courses bring the student out at the same point. It is obviously to the advantage of the student to take a course in chemistry in high school and thus obviate the extra hours of Courses 1 and 2 in the freshman year.

1. **I.** General Chemistry. — For freshmen. This course is for those students who do not present chemistry for entrance and who begin the subject in college. An introduction to the fundamental chemical laws, together with a study of the common acid-forming elements and their compounds.
3 class hours. 2 2-hour laboratory periods, 5 study hours, credit, 12.
Professor Peters.

2. **II.** Agricultural Chemistry. — For freshmen. The preparation of a number of substances important in agriculture, such as superphosphate, ammo-

nium sulfate, muriate and sulfate of potash, Paris green, arsenate of lead, Bordeaux mixture, lime-sulfur and emulsions. These materials are prepared in the laboratory and studied in detail in the classroom; some of the substances prepared may be analyzed. Particular attention will be given to a study of the composition, properties and reactions of soils. Approximate quantitative determinations of a number of constituents of soils and fertilizers will be made.
3 class hours. 2 2-hour laboratory periods, 5 study hours, credit, 12.
Professor PETERS.

4. **I.** ADVANCED GENERAL CHEMISTRY. — For freshmen. A review of the fundamental chemical laws, together with the common acid and base-forming elements and their compounds. Textbook, Holmes' "General Chemistry." The laboratory work takes the synthetic form. Substances of agricultural importance are prepared in quantity and studied in detail by the student. These include ammonium sulfate, superphosphate, muriate and sulfate of potash, arsenate of lead, Paris green, Bordeaux mixture, lime-sulfur and emulsions.
2 class hours. 2 2-hour laboratory periods, 4 study hours, credit, 10.
Assistant Professor SEREX.

Prerequisite, Entrance Chemistry.

5. **II.** INORGANIC AGRICULTURAL CHEMISTRY. — For freshmen. A study of the chemical composition, properties and reactions of soils, fertilizers, fungicides and insecticides. The laboratory work is divided into three parts: (*a*) qualitative examination of soil, plant ash and superphosphate; (*b*) approximate quantitative determination of moisture, ash, carbonic acid, phosphoric acid, potash, etc.; (*c*) special work on retention of salts by soil, leaching of lime from the soil by carbonated water, etc.
2 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 9.
Assistant Professor SEREX.

25. **I.** QUALITATIVE ANALYSIS. — *Basic.* — For sophomores. The systematic analysis of metallic salts, presented from the ionic viewpoint. A close study of the tests used in the separation and identification of the metals, and the application of these tests to unknown mixtures. Text, Medicus' "Qualitative Analysis," with Stieglitz's "Qualitative Analysis" and Gooch and Browning's "Qualitative Analysis" for reference. This course should be taken by all intending to follow chemistry as a vocation.
1 class hour. 2 2-hour laboratory periods, 4 study hours, credit, 9.
Assistant Professor SEREX.

Prerequisite, Chemistry 2 or 5.

26. **II.** QUALITATIVE ANALYSIS. — *Acidic.* — For sophomores. A continuation of Course 25.
1 class hour. 2 2-hour laboratory periods, 4 study hours, credit, 9.
Assistant Professor SEREX.

30. **II.** ORGANIC AGRICULTURAL CHEMISTRY. — For sophomores; juniors and seniors may elect. Embraces the study of the most important groups of organic compounds of plants and animals, the composition of plants, the chemistry of plant growth, plants as food and as industrial material, the composition of animals, the chemistry of digestion, also the study of some of the products related to plants and animals, such as milk, butter, cheese, sugar and alcohol. The treatment of the subject is general, avoiding (so far as possible) complicated chemical facts and relationships, and endeavoring simply to make the student acquainted with the general chemistry of plants and animals and agricultural processes and products.
3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
Professor CHAMBERLAIN.

Elective Courses.

51. **I.** Organic Chemistry. — For juniors; seniors may elect. Consists of a systematic study, both from texts and in the laboratory, of the more important compounds in the entire field of organic chemistry. Especial attention is given to those compounds which are found in agricultural products or are manufactured from them. These include alcohols, acids, esters, fats, carbohydrates and proteins. The work forms a foundation for courses in physiological chemistry and agricultural analysis, and is especially planned for those majoring in chemistry or the other sciences. Those electing Course 51 are expected to elect Course 52.
3 class hours. 2 3-hour laboratory periods, 3 study hours, credit, 12.
Professor Chamberlain.
Prerequisites, Chemistry 2 or 5, and Chemistry 26 for those majoring in chemistry.

52. **II.** Organic Chemistry. — For juniors; seniors may elect. A continuation of Course 51.
3 class hours. 2 3-hour laboratory periods, 3 study hours, credit, 12.
Professor Chamberlain.

53. **III.** Organic Chemistry. — For juniors; seniors may elect. A continuation of Courses 51 and 52, dealing principally with compounds of the benzene series.
3 class hours. 2 3-hour laboratory periods, 3 study hours, credit, 12.
Professor Chamberlain.

61. **I.** Quantitative Analysis. — For juniors; seniors may elect. Includes the gravimetric and volumetric determinations of some of the commoner metals and non-metals. Smith's "Quantitative Chemical Analysis" is used as a text.
1 class hour. 2 4-hour laboratory periods, 3 study hours, credit, 12.
Professor Peters.
Prerequisite, Chemistry 25. Course 26 is prerequisite for those majoring in chemistry.

62. **II.** Advanced Quantitative Analysis. — For juniors; seniors may elect. Advanced work on subjects as stated under Course 61, together with the analysis of insecticides or the analysis of soils and fertilizers.
2 class hours. 2 4-hour laboratory periods, 2 study hours, credit, 12.
Professor Peters.
Prerequisite, Chemistry 61.

63. **III.** Milk and Butter Analysis. — For juniors; seniors may elect. A study of milk and butter analytically.
1 class hour. 2 4-hour laboratory periods, 3 study hours, credit, 12.
Professor Peters.
Prerequisite, Chemistry 61.

75. **I.** Physical Chemistry. — For seniors. A résumé of general chemistry from the viewpoint of physical chemistry, and the application of physical chemistry to agricultural chemistry.
3 class hours. 6 laboratory hours, 3 study hours, credit, 12.
Assistant Professor Serex.
Prerequisite, Chemistry 61.

80. **I.** Physiological Chemistry. — For seniors. Supplementary to Courses 51, 52 and 53. To those who expect to take up scientific work in microbiology, botany, agronomy, animal husbandry, etc., and who have had Courses 51, 52 and 53, it gives acquaintance with the chemistry of the physiological processes in plants and animals, by means of which some of the important organic compounds studied

in Courses 51, 52 and 53 are built up in the living organism or are used as food by it. In the lectures the study of food and nutrition as related to both human and domestic animals is the principal subject. In the laboratory experimental studies are made of the animal body and the processes and products of digestion, secretion and excretion.

3 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 10.
Professor Chamberlain.

86. **II.** Review of General Chemistry. — For seniors. Primarily for students majoring in chemistry; others may elect by permission from the instructor. A knowledge of physical chemistry is desirable. The review of general chemistry is largely theoretical, using Alexander Smith's "Introduction to Inorganic Chemistry" as text.

3 class hours. 6 study hours, credit, 9.
Professor Peters.

87. **III.** History of Chemistry. — For seniors. An historical and biographical study of chemistry and chemists. The aim of the course is: (1) to give the student a comprehensive view of the science as a whole, through a study of the development of new ideas and the establishment of new theories and laws; and (2) to arouse an enthusiastic interest in the subject and an appreciation of the true spirit of scientific research through a sympathetic presentation of the work and lives of the great chemists who have been the creators of the chemistry of to-day. The course will consist of lectures, supplemented by systematic correlated reading, and the preparation of reports or essays.

3 class hours. 6 study hours, credit, 9.
Professor Chamberlain.

90. **II.** Special Work in Chemical Problems. — For seniors. The student is given a problem in analytical chemistry or one related to the agricultural industries. This is to acquaint him with the methods used in research and with chemical literature. Special subjects such as cattle feed or water analysis may be taken if desired.

8 laboratory hours, 4 study hours, credit, 12.
Professor Peters.

91. **III.** Special Work in Chemical Problems. — For seniors. As stated under Course 90.

8 laboratory hours, 4 study hours, credit, 12.
Professor Peters.

92. **II.** Special Work in Physiological and Organic Agricultural Chemistry. — For seniors. In this course, as in Courses 90 to 95, the student may give his attention primarily to one line of chemical study. To those whose tastes and interests are in connection with the organic and physiological problems of agricultural chemistry, many subjects of study present themselves, among which may be mentioned: proteins, carbohydrates, fats, organic nitrogenous compounds in fertilizers and soils and their relation to plants, the commercial production of alcohol from agricultural products, dyes, digestion and dietary studies, the chemical study of dairy products, etc.

1 class hour. 8 laboratory hours, 3 study hours, credit, 12.
Professor Chamberlain.

Prerequisites. Chemistry 51, 52, 53 and 80.

93. **III.** Special Work in Physiological and Organic Agricultural Chemistry. — For seniors. As stated under Course 92.

1 class hour. 8 laboratory hours, 3 study hours, credit, 12.
Professor Chamberlain.

Prerequisite, Chemistry 92.

94. **II.** Special Work in Physical Chemistry. — For seniors. The field of agricultural chemistry offers many problems that have been attacked through the methods of physical chemistry; such, for example, are the hydrolysis of salts and of minerals and the absorption of salts and fertilizers by soils. Each student selects one line of work and follows it through the course, repeating some of the original work.
1 class hour. 8 laboratory hours, 3 study hours, credit, 12.
Assistant Professor Serex.

Prerequisite, Chemistry 75.

95. **III.** Special Work in Physical Chemistry. — For seniors. As stated under Course 94.
1 class hour. 8 laboratory hours, 3 study hours, credit, 12.
Assistant Professor Serex.

Prerequisite, Chemistry 94.

Entomology.

Professor Fernald, Professor Crampton, Assistant Professor Alexander, Assistant Professor Cassidy.

Introductory Course 26 or 28 presents a comprehensive view of the relation of insects to man, particularly as crop pests. The most important pests are carefully studied, together with the methods for their control. Courses 50 and 51 are arranged for special study of the pests of any one line of agricultural or horticultural occupation, selected by the student according to his plan of future work, with the intent of making him thoroughly familiar with the pests he will meet in his selected work after graduation, and the means of controlling them. The remaining courses are for the training of men as State or experiment station entomologists; for those going into the care of trees, etc., on estates, or for cities and towns; and as entomological experts, for which the demand has been very large.

Fernald Hall provides excellent lecture rooms and laboratories for this department. The laboratories are provided with individual desks, equipped with microscopes and all needed apparatus of all kinds. Dissecting microscopes, binoculars, microtomes, photographic apparatus, glassware and reagents are available for use and electric light and gas are connected with each desk. Two laboratories, one for juniors and seniors, the other for graduate students, are thus equipped. A department library containing all the more important works on insects, supplemented by others on the subject in the main library, and by the private libraries of the professors, make available more than 25,000 books and pamphlets on this subject. In addition, all the current magazines are received and their files are accessible to every one. A card catalogue giving references to the published articles on different insects contains about 65,000 cards, and is probably the largest index of its kind in the world. Spray pumps, nozzles and spraying appliances of all kinds are in use in various parts of the courses, and a large collection of insecticides is accessible for study. Photographic rooms are specially prepared for the photography of insects, and the greenhouses, gardens, orchards and the grounds of the college provide wide opportunities for the study, under natural conditions, of insect pests.

Course 26 or 28 is required of sophomores in the Divisions of Horticulture, Landscape Gardening, Science and Rural Social Science.

26. **III.** General and Economic Entomology. — For sophomores; juniors and seniors may elect. For students who desire some knowledge of insects, but who cannot give more than one term to the subject; also an introduction to the later courses for those who intend to follow entomology further. Touches briefly upon the structure of insects so far as this is needed for such a course; deals with metamorphosis, classification to the larger groups, and discusses the most important methods and materials used for control. The greater part of the time is devoted to special study of the most important insect pests, particularly of New England,

showing their modes of life, the injuries they cause, and the best methods of control. In this way the most serious pests of fruit trees, ornamental trees and shrubs, market-garden and green-house pests, those attacking field crops and those affecting animals and man, are treated.
5 class hours. 4 study hours, credit, 9.
Professor Fernald.

28. **III.** General and Economic Entomology. — The same as 26 to about May 1; thereafter two class exercises and three laboratory or field exercises per week. In the field the work of insects found will be studied and collections of insects made. Methods of collecting, preparing and mounting insects for collections will be taught. Class limited to 30 members.
5 class hours, 4 study hours to about May 1;
2 class hours. 3 2-hour laboratory periods, 1 study hour thereafter, credit, 9.
Professor Fernald.

50. **I.** Pests of Special Crops. — For juniors; seniors may elect. For students not majoring in entomology. The laboratory work is largely individual in this term. Accordingly, students majoring in subjects other than entomology, but who desire a more complete knowledge of the insects connected with their own major line of work, can obtain it here. A student majoring in floriculture, for example, will devote his laboratory time to a careful study of the insects injuring floricultural crops, learning how to recognize them and their work in their different stages, and the best methods for their control. Courses of this kind are available on the insects attacking field crops, market-garden crops, tree fruits, small fruits, shade trees and shrubs, flowers, forest trees, the domesticated animals, household pests and man. This work may be continued in the winter term also. (See Course 51, **II.**)
3 2-hour laboratory periods, credit, 6.
Professor Fernald.

Prerequisite, Entomology 26 or 28.

51. **II.** Pests of Special Crops. — As stated in Course 50, **I.** For students not majoring in entomology. Those who were not able to take Entomology 50 in the fall may take it here. Those who took Entomology 50 in the fall have an opportunity to continue the work during this term also.
3 2-hour laboratory periods, credit, 6.
The Department.

Prerequisite, Entomology 26 or 28.

52. **I.** Classification of Insects. — For juniors specializing in entomology. Laboratory work on the identification and classification of insects of various groups.
4 2-hour laboratory periods, credit, 8.
Assistant Professor Alexander.

Accompanying Entomology 53.

53. **I.** Insect Morphology. — For juniors specializing in entomology and for other juniors or seniors having the prerequisite. The lectures treat of the external and internal anatomy of insects, particularly those parts used in identification, a knowledge of which is needed, in the accompanying Course 52. In the laboratory the external anatomy of the most important groups is studied, emphasizing the characters used in learning the names of insects, and to teach the methods of using analytical keys.
2 class hours. 3 2-hour laboratory periods, 4 study hours, credit, 12.
Professor Crampton.

Prerequisite, Entomology 26 or 28.

54. **I.** Insecticides and their Application. — Lectures on the composition, preparation and methods of application of Insecticides.
2 class hours, 2 study hours. Credit, 4.
Professor Fernald.
Prerequisite, Entomology 26 or 28.

55. **II.** Continuation of Course 52, one-half term. Insects and their relation to disease, one-half term.
4 2-hour laboratory periods, credit, 8.
Professors Crampton and Alexander.

56. **II.** Pests of Special Crops. — For juniors majoring in entomology. Individual laboratory work on the most important insect pests of this country, and the preparation and presentation of bulletin material on them.
3 2-hour laboratory periods, credit, 6.
The Department.

75. **III.** Forest and Shade-tree Insects. — For juniors; seniors may elect. The lecture work deals with the principles and methods of controlling insects which attack forests and forest products, shade trees, etc. The laboratory periods are devoted to a study of the more important species, their identification, biology and specific control measures. Field work supplements laboratory study if time permits. One entire Saturday for field excursion also required.
1 class hour. 3 2-hour laboratory or field periods, 1 study hour, credit, 8.
Assistant Professor Alexander.
Prerequisites, Entomology 26 or 28; 52 and 53 desirable.

76. **I.** Advanced Entomology. — For seniors. Studies on insect bionomics; scale insects, their structure, habits, methods of mounting, identification, etc.; studies of the animals not insects with which entomologists are expected to deal.
2 class hours. 3 2-hour laboratory periods, 3 study hours, credit, 11.
Professors Crampton and Alexander.
Prerequisite, Entomology 55.

77. **II.** Advanced Entomology. — Studies of the life history, habits and methods of control of the important insect pests of the United States; recognition tests of these pests and an examination of the literature on them; methods of bulletin preparation.
3 2-hour laboratory periods, 6 study hours, credit, 12.
Assistant Professor Alexander.
Prerequisite, Entomology 76.

78. **III.** Advanced Entomology. — Classification of insects and of their early stages; principles of classification, the use of literature on entomology and the preparation of bibliographies and indices; the enemies of insects.
1 class hour. 3 2-hour laboratory or field periods, 2 study hours, credit, 9.
Professors Fernald, Crampton and Alexander.
Prerequisite, Entomology 77.

90. **II.** Evolution. — For juniors; seniors may elect. In order to demonstrate the universal scope and operation of the laws of evolution, the course includes a brief sketch of the probable origin and evolution of matter as viewed in the light of modern physical and chemical research; the evolution of the solar system, leading to the formation of the earth; the changes in the earth, preparatory to the production of life; the physical and chemical basis of life; the probable steps in the formation of living matter, and the theories concerning it; the evolution of living things; the developmental history of man, and of the races of mankind; the evolution of human intelligence, languages, culture, institutions, etc., and man's probable future in the light of his past development. Especial consid-

eration is given to the factors of evolution, the basic principles of heredity, variation and similar topics, with particular reference to their application to human welfare; and the recent contributions in the field of entomology to the advancement of our knowledge of these fundamental principles are briefly reviewed.
3 class hours. 4 study hours, credit, 7.
Professor CRAMPTON.

Courses in Beekeeping.

65. **III.** INTRODUCTORY BEEKEEPING. — For juniors. A detailed study of the normal behavior of the honey bee and the colony as a whole, followed by a study of such practical work of the apiary as is carried on in spring and summer. In so far as possible the laboratory work parallels the lecture work, and both are made to follow the seasonal processes of the colony. Spring management, swarm control and the production and care of the honey crop are covered thoroughly. The course is designed to meet the needs of the horticulturist as well as those of the honey producer, and should be followed by Course 85, **I.**
1 class hour. 2 2-hour laboratory periods, 3 study hours, credit, 8.
Assistant Professor CASSIDY.

85. **I.** INTRODUCTORY BEEKEEPING. — For seniors. A continuation of Course 65 and a completion of the beekeeping year. Fall management, preparation for winter and wintering are studied in detail in lectures and laboratory work. Original problems for student solution. It is highly advisable for those taking Course 65 to take Course 85, and thus complete the annual cycle of beekeeping activity.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Assistant Professor CASSIDY.

86. **III.** ADVANCED BEEKEEPING. — For seniors. A study of the special problems with which the beekeeper deals. The diagnosis and control of the various bee diseases, production of wax, sources of nectar, honey, bee anatomy and physiology, and marketing of the crop are some of the principal topics discussed. The course is designed for those who intend going into honey production either as a principal occupation or as a side line. Field trips to commercial apiaries; laboratory practice in queen rearing.
2 class hours. 1 2-hour laboratory period, 4 study hours, credit, 8.
Assistant Professor CASSIDY.

Mathematics and Civil Engineering.

Professor OSTRANDER, Professor MACHMER, Assistant Professor MOORE, Mr. PORTER.

The work of the freshman year is required. It is intended to furnish the necessary drill and groundwork needed for many of the scientific and practical courses of other departments. Thoroughness and accuracy are insisted upon. The advanced work in mathematics is taught from a practical standpoint, and many of its applications to other subjects are given. The courses in surveying and civil engineering are given to furnish the groundwork for a professional career. Special emphasis is given to the subjects bearing on highway construction and maintenance.

For drawing, a room on the north side is used for the draughting. It has draughting tables, T squares, scales, etc., for twenty students. Vernier protractors, parallel rules and steel T squares are available for precise work. A small room is devoted to blue printing.

In surveying, the department has a considerable number of chains and tapes, two railroad compasses, a builder's level, two dumpy levels, two Y levels and two old levels used for teaching the adjustments. Six transits are available for student use. Two are provided with solar attachments. An omnimeter with vernier reading to ten seconds is available for geodetic work. A hand level, mining aneroid barometer, and prismatic compass are provided for reconnoissance work. A set of Gilmor's needles and a Fairbanks' machine are used for cement testing.

Required Courses.

1. **I.** Higher Algebra. — For freshmen. A brief review of radicals, quadratic equations, ratio and proportion, and progressions; graphs, binomial theorem, undetermined coefficients, summation of series, variation, continued fractions, determinants, permutations and combinations, logarithms, theory of equations. Reitz and Crathorne's "College Algebra."
4 class hours, 6 study hours. Credit, 10.
Professors Machmer, Moore and Mr. Porter.

2. **II.** Higher Algebra. — As stated under Course 1. Required of all who present solid geometry for entrance.
3 class hours, 4 study hours. Credit, 7.
Professors Machmer, Moore and Mr. Porter.

3. **II.** Solid Geometry. — For freshmen. Theorems and exercises on the properties of straight lines and planes, dihedral and polyhedral angles, prisms, pyramids and regular solids; cylinders, cones and spheres; spherical triangles and the measurement of surfaces and solids. Wentworth and Smith's "Solid Geometry." Required unless accepted for admission.
3 class hours, 4 study hours. Credit, 7.
Professors Machmer, Moore and Mr. Porter.

4. **II.** Mensuration and Computation. — For freshmen. A review of methods of computation, with special emphasis on short and abbreviated processes, together with methods of checking computations and of forming close approximations; use of slide rule. Also the graph, mensuration of plane and solid figures, weights and measures and elementary mechanism. Numerous practical problems are selected from such subjects as the following: the mathematics of woodworking; rough lumber; general construction; forestry methods in heights of trees; pulleys, belts and speeds; power and its transmission; dairying; agronomy; computation of areas from simple measurements.
2 class hours, 3 study hours. Credit, 5.
Professor Machmer and Mr. Porter.

5. **III.** Plane Trigonometry. — For freshmen. The trigonometric functions as lines and ratios; proofs of the principal formulas, transformations; inverse functions, use of logarithms; the applications to the solution of right and oblique triangles; practical applications. Bowser's "Elements of Plane and Spherical Trigonometry."
3 class hours, 6 study hours. Credit, 9.
Professors Machmer, Moore and Mr. Porter.

Elective Courses.

26. **II.** Plane Surveying. — For sophomores; juniors and seniors may elect. The elements of the subject, including the adjustment and use of the usual instruments. Textbook and lectures.
3 class hours, 6 study hours. Credit, 9.
Professors Ostrander and Moore.

27. **III.** Plane Surveying. — For sophomores; juniors and seniors may elect. As stated under Course 26. Includes field work.
3 2-hour laboratory periods, 4 study hours, credit, 10.
Professors Ostrander and Moore.
Prerequisite, Mathematics 26.

50. **I.** ANALYTIC GEOMETRY. — For juniors; seniors may elect. A discussion of the geometry of the line, the circle, conic sections, and the higher plane curves. Fine and Thompson's "Co-ordinate Geometry."
3 class hours. 6 study hours, credit, 9.
Professor MACHMER.

Prerequisites, Mathematics 1, 2, 3 and 5.

51. **II.** DIFFERENTIAL AND INTEGRAL CALCULUS. — For juniors; seniors may elect. A first course in the subject, with some of the more important applications. Granville's "Differential and Integral Calculus."
5 class hours. 10 study hours, credit, 15.
Assistant Professor MOORE.

Prerequisites, Mathematics 1, 2, 3 and 5.

52. **III.** INTEGRAL CALCULUS. — For juniors; seniors may elect. A continuation of Course 51.
5 class hours. 10 study hours, credit, 15.
Assistant Professor MOORE.

Prerequisite, Mathematics 51.

53. **II.** ELEMENTARY STRUCTURES. — For juniors; seniors may elect. An elementary course in roofs and bridges. Textbook and lectures.
3 class hours. 1 2-hour laboratory period, 6 study hours, credit, 11.
Professor OSTRANDER.

75. **I.** HYDRAULICS AND SANITARY ENGINEERING. — For seniors; juniors may elect. Hydrostatics, theoretical hydraulics, orifices, weirs, pipes, conduits, water supply, hydraulic motors, sewers and sewage treatment. Textbook and lectures.
5 class hours. 10 study hours, credit, 15.
Professor OSTRANDER.

76. **I.** MATERIALS OF CONSTRUCTION. FOUNDATIONS AND MASONRY CONSTRUCTION. — For seniors; juniors may elect. Textbook and lectures.
5 class hours. 10 study hours, credit, 15.
Professor OSTRANDER.

77. **II.** ROADS AND RAILROADS. — For seniors; juniors may elect. Topographic and higher surveying, highway construction, earthwork, pavements and railroad construction. Textbook and lectures.
3 class hours. 6 study hours, credit, 9.
Professor OSTRANDER.

78. **III.** ROADS AND RAILROADS. — For seniors; juniors may elect. As stated under Course 77.
3 2-hour laboratory periods, credit, 6.
Professor OSTRANDER.

Prerequisite, Mathematics 77.

Microbiology.

Professor MARSHALL, Assistant Professor WERKMAN, Dr. NELSON, Miss GARVEY.

Three objectives are sought in the arrangement of the courses following: (1) Introductory courses (50 and 51) needed in the general training of every college student. (2) An introductory course followed by a specific course (as 80, 81, 82, 83), necessary to every student engaged in the Division of Agriculture, with which the specific course deals. (3) Introductory courses (50 and 51) followed by Courses 52, 75, 76 and 81, preparatory for students who are aiming to specialize in agricultural microbiology. (Courses 75, 76 and 81 are adapted to those having Courses 50 and 51 only, and are also adapted to those majoring in microbiology.)

The microbiological work is carried on in a building especially designed for it.

There are 4 class laboratory rooms, 8 private laboratory rooms, 1 lecture room, 5 incubator rooms, 3 sterilizing rooms, 3 hood rooms, 3 washing rooms, 3 inoculating rooms, 3 weighing rooms, an animal room, a photographic and dark room, a sub-basement refrigerator room, a library and 4 office rooms.

The class laboratory rooms are so arranged that individual desks are available for student use. Hot and cold water and gas connections are convenient for each desk; high-pressure steam and electric connections are also available. The building is well lighted and of sanitary construction; all the walls are of brick, and the building is fireproof.

The library is equipped with such books and current periodicals as are useful in the conduct of bacteriological work and investigations. Twenty-four scientific magazines are available regularly.

There are incubators, both electric and gas, hot-air sterilizers, ordinary steam sterilizers, autoclaves, an inspissator, blood-testing apparatus, vacuum apparatus, air-pressure apparatus, shaker, grinder, centrifugal machines, a water still of 5 gallons per hour capacity, Hoskins' combustion furnace, a balopticon, complete microphotographic equipment, microscopes, microtome, and such other apparatus, glassware and chemicals as are needed for extensive and intensive work.

Required Course.

30. **III.** Elementary Microbiology. — Required of sophomores majoring in the agricultural division. Designed to make micro-organisms real and significant to the student who seeks some knowledge of their activities. An attempt is made to place them among living organisms, to demonstrate their wide distribution in nature and to indicate what they do. Some of the essential methods of control and propagation are reviewed. Owing to the time limit, this course may be regarded as an introductory survey course only.

6 laboratory hours, credit, 6.

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Elective Courses.

50. **I, II** and **III.** Introductory and General Microbiology. — For juniors; seniors may elect. Aims to provide elementary basis for microbial studies and interpretation, to enable students to pursue special pertinent courses which will serve as supports in practical electives or majors, and to furnish students with such material as will be valuable in understanding public health problems.

2 class hours. 3 2-hour laboratory periods, 2 study hours, credit, 10.

Professor Marshall and —— ——.

51. **II** and **III.** Morphological, Cultural and Physiological Microbiology. — For juniors; seniors may elect. Types of micro-organisms, technic of handling, methods of culture and functions of micro-organisms are considered. This course is fundamental to all advanced and extended microbiological studies.

1 class hour. 6 laboratory hours, 3 study hours, credit, 10.

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Prerequisite, Microbiology 30 or 50.

52. **III.** Advanced Morphological, Cultural and Physiological Microbiology. — For juniors; seniors may elect. Prepares for a more intimate knowledge of microbiological agricultural problems. To accomplish this object it is necessary to provide more advanced technique and methods of culture, together with a more extensive knowledge of micro-organisms and their functions.

1 class hour. 5 laboratory hours, 4 study hours, credit, 10.

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Prerequisite, Microbiology 51.

60. **I.** Public Health. — For juniors; seniors may elect. Considers the relation of the human body to its environment in the maintenance of health and the production of disease. This study is based upon human anatomy and physi-

ology. The individual, as a member of society, governed by natural laws, is also of fundamental importance. A knowledge and an interpretation are sought of the usual agencies connected with health and disease, as air, water, sewage, dairy products, foods, drugs, carriers, vaccines and their prophylactic means, biological products as diagnostic and remedial materials and public health practices now recognized. Diseases of public health significance are reviewed, their control considered and their social values discussed.
3 class hours, 6 study hours. Credit, 9.
Professor Marshall and Miss Garvey.

61. **II.** Public Health. — For juniors; seniors may elect. As stated under Course 60.
3 class hours, 6 study hours. Credit, 9.
Professor Marshall and Miss Garvey.

62. **III.** Public Health. — For juniors; seniors may elect. As stated under Course 60.
3 class hours, 6 study hours. Credit, 9.
Professor Marshall and Miss Garvey.

75. **II.** Agricultural Microbiology. — For seniors; juniors may elect. This general comprehensive course is designed to cover in an elementary manner those subjects only which confront the student of general agriculture, — the microbiological features of air, water, sewage, soil, dairy, fermentations, food, vaccines, antisera, microbial plant infections, methods and channels of infections, immunity and susceptibility, microbial infections of man and animals, methods of control or sanitary and hygienic practices.
1 class hour. 5 laboratory hours, 4 study hours, credit, 10.
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Prerequisite, Microbiology 51.

76. **III.** Agricultural Microbiology. — For seniors; juniors may elect. As stated under Course 75.
1 class hour. 5 laboratory hours, 4 study hours, credit, 10.
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Prerequisite, Microbiology 75.

80. **II.** Soil Microbiology. — For seniors; juniors may elect. Such subjects as the number and development of micro-organisms in different soils; the factors which influence their growth, food, reaction, temperature, moisture and aeration; the changes wrought upon inorganic and organic matter in the production of soil fertility, ammonification, nitrification and denitrification; fixation of nitrogen symbiotically and non-symbiotically; methods of soil inoculation receive attention.
1 class hour. 5 laboratory hours, 4 study hours, credit, 10.
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Prerequisite, Microbiology 51.

81. **I.** Hygienic Microbiology. — For seniors; juniors may elect. An attempt is made to select certain material which is basic to public hygiene and sanitation, as applied to man and animals. The microbiology of water supplies, food supplies, vaccines, antisera or antitoxins; the channels by which micro-organisms enter the body, the influence of body fluids and tissues upon them, body reactions with micro-organisms (susceptibility and immunity); the micro-organisms of some of the most important infectious diseases, methods of control, including disinfectants and disinfection, antiseptics, antisepsis and asepsis, are treated.
1 class hour. 5 laboratory hours, 4 study hours, credit, 10.
——————.

Prerequisite, Microbiology 51.

82. **I.** Dairy Microbiology. — For seniors; juniors may elect. Special emphasis is placed upon milk supplies. The microbial content of milk, its source, its significance, its control; microbial taints and changes in milk; groups or types of organisms found in milk; milk as a carrier of disease-producing organisms; the value of straining, aeration, clarification, centrifugal separation, temperature, pasteurization; the abnormal fermentations of milk; bacteriological milk standards and their interpretation; ripening of milk and cream; the bacterial content of butter; a passing survey of the microbiology of cheeses; a study of special dairy products, as ice cream, condensed milk, artificial milk drinks (the products of microbial actions), represents a list of topics considered.
1 class hour. 5 laboratory hours, 4 study hours, credit, 10.
Professor Marshall and Miss Garvey.
Prerequisite, Microbiology 51.

83. **III.** Food Microbiology. — For seniors; juniors may elect. A study of the principles of food preservation, and food preservation by means of drying, canning, refrigerating and addition of chemicals, is pursued. Food fermentations, as illustrated by bread, pickles, sauerkraut, ensilage, vinegar, wine, etc., are examined. Decomposition of foods, as may be seen in meat, oysters, fish, milk, etc., as well as diseased and poisonous foods, receive consideration. Contamination of food supplies by means of water, sewage, handling, exposure, diseased persons, etc., is of especial significance, and is demonstrated by laboratory exercises. Laboratory inspection of foods is now a subject of great import and is given attention.
1 class hour. 5 laboratory hours, 4 study hours, credit, 10.
Professor Marshall and Miss Garvey.
Prerequisite, Microbiology 51.

Physics.

Professor ——, Professor ——, Mr. Alderman.

The fundamental and basic importance of the laws and phenomena of physics makes necessary no explanation of the introduction of this subject into the curriculum of an agricultural college. The logical development of the subject emphasizes the importance of physics as a science in itself. Special emphasis is laid, however, on the correlation of the principles studied with the sciences of agriculture, botany, chemistry and zoölogy, thus furnishing an extra tool by use of which the student's work in all the subjects may be more effective.

In Courses 25, 26 and 27 the subject-matter is presented with the idea of its special application primarily in the work in agriculture and general science. The full year's work is required of all students continuing work specifically in the Division of Science. Course 25 is required of all students. The subject-matter is especially selected and arranged for its practical application rather than its theoretical development. Courses 50, 51 and 52 are advised for students in chemistry, general biology, microbiology and general science. The subject-matter is selected, and the courses developed, with the idea of making the student proficient in laboratory manipulation. Sufficient theory is given in connection with the work to enable the student to apply the knowledge and practice thus gained in the department indicated above.

The department has at its command a building on the east campus, containing a general lecture room and laboratory for sophomore work, a laboratory for junior work, and in the basement one small laboratory for quantitative work in light measurement. There is also in the basement a fairly well-equipped shop for the repair and construction of apparatus used in the department work. The usual apparatus for the demonstration in the lecture room is in the possession of the department.

Required Courses.

25. **I.** General Physics. — For sophomores. Mechanics of solids and fluids. This course includes statics, with equilibrium of rigid bodies, work, energy and friction; kinetics, considering rectilinear motion and motion in a curved path;

harmonic motion; rotation of rigid bodies, including kinematics of rotation; liquids and gases, with properties of fluids at rest and in motion; properties of matter and its internal forces, including elasticity, capillarity, surface tension.
3 class hours. 1 2-hour laboratory period, 4 study hours, credit, 9.
Professor ——— and Mr. ALDERMAN.

26. **II.** ELECTRICITY AND MAGNETISM. — For sophomores. Includes such subject-matter as magnetism, electrostatics, electric currents with their production, chemical, heating and mechanical effects; battery cells, measurement of voltage, current flow and resistance, motors and generators.
3 class hours. 1 2-hour laboratory period, 4 study hours, credit, 9.
Mr. ALDERMAN.

27. **III.** HEAT AND LIGHT. — For sophomores; juniors and seniors may elect. Thermometry, expansion, colorimetry and specific heat, transmission of heat, changes of state, radiation and absorption. Wave theory of light, optical instruments, analysis of light, color, interference, diffraction, polarization.
3 class hours. 1 2-hour laboratory period, 4 study hours, credit, 9.
Professor ——— and Mr. ALDERMAN.

Elective Courses.

50. **I.** 51. **II.** 52. **III.** EXPERIMENTAL PHYSICS. HEAT, LIGHT, ELECTRICITY AND MAGNETISM. — For juniors; seniors may elect. This course consists of a series of physical measurements in the laboratory, accompanied by lectures. The lectures deal chiefly with the methods and principles involved in the laboratory work. High-grade instruments of precision are employed in the laboratory work, and the student is expected to acquire some ability to make accurate observations. The primary object of the course is to develop in the student scientific habits of thinking by direct personal observation of physical phenomena.
1 class hour. 2 2-hour laboratory periods, 4 study hours, credit, 9.
———.

Prerequisite, Physics 27.

55. **III.** ANALYTICAL MECHANICS. — For juniors; seniors may elect. An introduction to the application of the calculus to the mechanics of solids; statics and kinetics of rigid bodies; elasticity; vector analysis. For students who have taken or are taking Mathematics 52.
3 class hours, 6 study hours. Credit, 9.
Mr. ALDERMAN.

75. **I.** 76. **II.** 77. **III.** THEORY OF LIGHT. — For seniors. Propagation of light, formation of optical images, photography, optical instruments, interference, diffraction, spectroscopy, optical phenomena of the atmosphere, polarization and double refraction, magneto-optics, photo-electricity, radiation, electromagnetic waves, X-rays and crystal structure, electron theory, principle of relativity. Not given 1924–25.
3 class hours, 6 study hours. Credit, 9.
———.

Prerequisite, Mathematics 51.

Veterinary Science and Animal Pathology.

Professor GAGE, Assistant Professor LENTZ, Assistant Professor PYLE.

The courses in veterinary science have been arranged to meet the needs (1) of students who propose following practical agriculture; (2) of prospective students of human and veterinary medicine; and (3) of teachers and laboratory workers in the biological sciences.

The department occupies a modern laboratory and hospital stable, built in accordance with the latest principles of sanitation. Every precaution has been taken in the arrangement of details to prevent the spread of disease, and to provide for effective heating, lighting, ventilation and disinfection.

The main building contains a large working laboratory for student use, and several small private laboratories for special work. There is a lecture hall, a museum, a demonstration room, a photographing room and a workshop. The hospital stable contains a pharmacy, an operating hall, a post-mortem and dissecting room, a poultry section, a section for cats and dogs, and 6 sections, separated from each other, for horses, cattle, sheep and swine. The laboratory equipment consists of a dissectible Auzoux model of the horse and Auzoux models of the foot and the leg, showing the anatomy and the diseases of every part. The laboratories also have modern, high-power microscopes, microtomes, incubators and sterilizers, for work in every department of veterinary science, including pathology, serology and parasitology. There are skeletons of the horse, the cow, the sheep, the dog and the pig, and a growing collection of anatomical and pathological specimens. The lecture room is provided with numerous maps, charts and diagrams.

Elective Courses.

50. **II.** Veterinary Hygiene and Stable Sanitation. — For juniors; seniors may elect. Familiarizes students with the relation of water, food, air, light, ventilation, care of stables, disposal of excrement, individual hygiene, etc., to the prevention of disease in farm animals.
5 class hours. 3 study hours, credit, 8.
Assistant Professor Lentz.

53. **I.** Gross Veterinary Anatomy. — For juniors; seniors and graduate students may elect. The detailed study of the skeleton is followed by dissection of the muscular system and the study of joints. Not offered in 1924–25.
2 3-hour laboratory periods, 2 study hours, credit, 8.
The Department.

54. **II.** Gross Veterinary Anatomy. — For juniors; seniors and graduate students may elect. The continuation of Veterinary 53, consisting of dissection and study of the circulatory, nervous, digestive, respiratory, and genito-urinary systems. Not offered in 1924–25.
2 3-hour laboratory periods, 2 study hours, credit, 8.
The Department.
Prerequisite, Veterinary 53.

75. **I.** Comparative (Veterinary) Anatomy. — For seniors; juniors may elect. The anatomy of the horse is studied in detail, and that of other farm animals, particularly the ox. This course is essential for those students wishing to elect Course 77. It is a lecture and demonstrational course and open to all students interested. It is not a course in dissection anatomy.
5 class hours. 3 study hours, credit, 8.
Assistant Professor Lentz.

76. **II.** General Veterinary Pathology. — For seniors; juniors may elect. Fundamental, general, pathological conditions, as for example, inflammation, fever, hypertrophy, atrophy, etc., a knowledge of which is essential in prevention, diagnosis, and treatment of disease, are studied. The course in pathology is followed by a brief consideration of materia medica, therapeutic measures, and poisonous plants.
5 class hours. 3 study hours, credit, 8.
Assistant Professor Lentz.

77. **III.** Applied General Pathology. — For seniors; juniors may elect. This course is a continuation of Course 76. Particular attention is given to the etiology, the pathogenesis and the prophylaxis of the communicable and non-communicable diseases of the different species of domesticated animals. Lectures and demonstrations.
5 class hours. 3 study hours, credit, 8.
Assistant Professor Lentz.
Prerequisites, Veterinary 75 or Veterinary 78, 79 and 80.

78. **I.** Essentials of General Pathology. — For seniors; juniors may elect. Introduces students to some of the essential anatomical, histological and general physiological phenomena essential to the understanding of some of the simple general pathological conditions found in domestic animals. Some of the common methods of diagnosis are considered in the laboratory. The various chemical and biological reactions and tests are presented from the standpoint of pure science, showing applications of chemistry and biology. The course serves to educate liberally and stimulate in the student of agriculture the appreciation of some of the methods used in animal pathology for detecting and controlling some of the more common animal diseases. Lectures, demonstration and laboratory work.
2 3-hour laboratory periods, 2 study hours, credit, 8.
Professor Gage.

79. **II.** Essentials of General Animal Pathology. — For seniors; juniors may elect. A continuation of Course 78, devoted to a study of some of the common pathological conditions by means of prepared sections, the aim being to demonstrate to the student abnormal animal histological structures commonly observed when material from various cases of animal diseases is prepared for microscopical study. Some of the biological products used in protecting animals against disease are considered.
2 3-hour laboratory periods, 2 study hours, credit, 8.
Professor Gage.
Prerequisite, Veterinary 78.

80. **III.** Essentials of General Animal Pathology. — For seniors; juniors may elect. As stated in Courses 78 and 79.
2 3-hour laboratory periods, 2 study hours, credit, 8.
Professor Gage.
Prerequisite, Veterinary 79.

85. **I.** Avian Pathology. — For seniors; juniors may elect. A course in poultry diseases. The object is to present information concerning the common diseases of poultry, their etiology, diagnosis and prevention. Consists of a systematic study of the diseases of the alimentary tract, liver and abdominal region, followed by a study of the diseases of the respiratory system, circulation and kidneys. The important disease-producing external and internal parasites are considered; also diseases of the skin and reproductive organs. Lectures and demonstrations.
2 3-hour laboratory periods, 2 study hours, credit, 8.
Assistant Professor Pyle.

86. **II.** Avian Pathology. — For seniors; juniors may elect. As stated under Course 85, also devoted to the study of some of the special diseases of poultry. Recent methods used in the control of these diseases are considered an opportunity offered the student for demonstrating various disease processes by means of prepared slides. Lectures, demonstrations and laboratory work.
2 3-hour laboratory periods, 2 study hours, credit, 8.
Assistant Professor Pyle.
Prerequisite, Veterinary 85.

87. **III.** Avian Pathology. — For seniors; juniors may elect. As stated under Courses 85 and 86.
2 3-hour laboratory periods, 2 study hours, credit, 8.
Assistant Professor Pyle.

Prerequisite, Veterinary 86.

Zoölogy and Geology.

Professor Gordon, Mr. Ring.

The facts and principles of the sciences of zoölogy and geology have important applications in industry and the arts, and with those of their sister sciences form a body of knowledge of value and interest with which the educated man finds it necessary to gain a close familiarity. The elective courses in this department stand as offerings to students who wish to supplement their work in other departments, or who, for any reason, wish to enlarge their knowledge in either zoölogy or geology. Students are encouraged to consult the department about any courses which may be available to them, and which might prove necessary or helpful for any line of work they may wish to follow.

The building occupied jointly by the department of entomology and the department of zoölogy and geology has for the work in zoölogy and geology laboratories equipped with gas, compound microscopes and the accessories needed for study in these subjects. The Zoölogical Museum has a representative collection of several thousand specimens of animals, and is drawn upon for material illustrating the various courses.

Zoölogy.

Required Course.

26. **II.** General Principles of Zoölogy. — For sophomores. An introductory course dealing with the basic features of animal structure, functions of organs, relations of animals to each other and some of the important principles and doctrines that have grown out of the study of animals.
2 class hours. 2 2-hour laboratory periods, 3 study hours, credit, 9.
The Department.

Elective Courses.

50. **I.** Synoptic Invertebrate Zoölogy; the Annelids and the Arthropods. — For juniors; seniors may elect. A study of the classes and orders of the annelid worms and the arthropods, exclusive of insects.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
The Department.

Prerequisite, Zoölogy 26.

51. **II.** Synoptic Invertebrate Zoölogy; the Molluscs and the Echinoderms. — For juniors; seniors may elect. A study of the classes and orders of the molluscs and echinoderms.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
The Department.

Prerequisite, Zoölogy 26.

52. **III.** Synoptic Invertebrate Zoölogy; Miscellaneous Invertebrate Phyla. — For juniors; seniors may elect. A study of various selected phyla of the non-vertebrated animals. For those who have not taken either or both of the preceding courses in synoptic invertebrate zoölogy this course may include representatives of the different phyla named therein.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
The Department.

Prerequisite, Zoölogy 26.

53. **I.** Elements of Microscopic Technique. — For juniors; seniors may elect. Gives the usual methods of preparing material for microscopic examination, including fixing, embedding, sectioning and differentiation by stains. May be supplemented by a study of selected normal tissues in connection with their physiological properties.

3 2-hour laboratory periods, credit, 6.
The Department.

75. **I.** Special Zoölogy. — Juniors, seniors and graduates may apply for such special work as they are qualified to undertake.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
The Department.
Prerequisite, Zoölogy 26.

76. **II.** Special Zoölogy. — Same as Course 75.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
The Department.
Prerequisite, Zoölogy 26.

77. **III.** Special Zoölogy. — Same as Course 75.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
The Department.
Prerequisite, Zoölogy 26.

79. **III.** Ornithology. — For juniors; seniors may elect. The taxonomic characters, distribution and habits of birds.
1 class hour. 2 2-hour laboratory periods, 2 study hours, credit, 7.
The Department.
Prerequisite, Zoölogy 26.

Geology.

52. **III.** General Geology. — For juniors; seniors may elect. A course in the various aspects of physical geology, dealing with materials of the earth's crust; their nature, origin and arrangement and the changes which they undergo.
2 class hours. 3 2-hour laboratory periods, 2 study hours, credit, 10.
Professor Gordon.

DIVISION OF THE HUMANITIES.

Professor Lewis.

Economics and Sociology.

Professor Lewis, Professor Sims,[1] Professor Mackimmie.

[Heavy-faced type indicates the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

The courses in economics and sociology are planned with the purpose of giving the student that knowledge and understanding of the important factors and problems in this field of study and life which every active citizen and educated man ought to have.

Required Course.

25. **I.** Introduction to Economic Principles and Problems. — For description of course see Course 50, **I.**
3 class hours, 6 study hours. Credit, 9.
Professor Mackimmie.

[1] Absent on leave.

Elective Courses.

26. **II.** Civilizations, Ancient and Modern. — For sophomores; others may elect. The evolutionary origin and history of man; characteristics of primitive man, departure from the animal status and beginnings of civilization; origin and development of industries, arts and sciences; the evolution of languages, warfare, migrations and social institutions; a study of the powerful natural and human forces that have brought man from the early stages to modern development; characteristic features of the leading civilizations and races of ancient and modern times; beneficial and dangerous factors in American life in view of the history of human civilization. Not given 1924–25.
5 class hours. ————.

50. **I.** Introduction to Economic Principles and Problems. — For juniors. Definitions of economic terms, such as wealth, capital, value, etc.; factors of production, exchange and consumption; principles of economic production, supply and demand, diminishing returns, division of labor, productive organization, concentration of capital and labor, trust and monopoly problems, public control of production and distribution; principles of exchange, theories of value, money and its problems; international trade, tariff and free trade theories, American merchant marine, reciprocity, and trade treaties; forms of income, wages, interest, rent, profits and the forces which govern them; principles of spending, economy, luxury, conservation of individual and national resources; principles and agencies for saving, investments, banks, building associations, insurance of all kinds; schemes for social organization; socialism, communism, industrial democracy. Textbook and readings.
5 class hours, 10 study hours. Credit, 15.
Professor Mackimmie.

51. **II.** Business and Industry. — For juniors and seniors. The forms, organization, administration and labor problems of business. Methods of organizing, financing and administering corporations and partnerships; forms of business administration, wholesaling, jobbing, retailing, advertising, credits and collections; system of industrial remuneration for wage earners, co-operation and preserving industrial peace; problems concerned with protective legislation for workmen and employers, sweated industries, prison labor, child labor and industrial education.
5 class hours, 7 study hours. Credit, 12.
Professor Mackimmie.

52. **III.** Public Finance, Taxation, Money and Banking. — For seniors. Systems and problems of taxation as they are found in Europe and America; objects for spending public revenue; public debts and methods of organizing them; systems of money and currency problems of America; types, methods and functions of banks; economic and financial crises and depressions in the United States; modern war finance. Readings and lectures.
5 class hours, 7 study hours. Credit, 12.
Professor Mackimmie.

75. **I.** Social Institutions and Social Reforms. — For seniors; juniors by permission. Social institutions, such as the family, the State, property, religions; and such current problems as eugenics, race suicide, divorce, crime and delinquent classes, prison reform, prevention and treatment of dependents and defectives, poverty, its causes and preventions; constructive modern social reform movements for insurance of wage earners, protection of childhood, assurance of safety, health and play time for all classes. The correctional and charitable institutions of Massachusetts are studied in considerable detail.
5 class hours, 10 study hours. Credit, 15.
Professor Sims.

History and Government.

Professor Lewis, Professor Mackimmie.

Required Courses.

25. **II.** American Government. — A study of the structure and operation of the machinery of our government; also a study of the history of its development from its inception to the present day.
3 class hours, 5 study hours. Credit, 8.
Professor Lewis.

27. **III.** Citizenship. — A course designed to acquaint the student with the most important and immediate problems of government — national, state and local — so that as a citizen he may make an intelligent contribution towards their solution. Lectures and discussions.
2 class hours, 4 study hours. Credit, 6.
Professor Lewis.

Elective Courses.

50. **I.** Government. — For juniors; seniors may elect. Forms and working methods of the government of Great Britain, Germany, France, Russia, Switzerland, New Zealand and Canada; historic types and theories of government; forms and methods of Federal, State and local governments in America; progress and problems of democracy and new reform movements in organization and administration; new tendencies towards social legislation and extension of governmental control.
3 class hours, 6 study hours. Credit, 9.
Professor Lewis.

51. **II.** Modern European History. — For juniors; seniors may elect. The modern history of the principal countries of Europe, especially the great movements and revolutions that developed the nations up to the present generation.
3 class hours, 6 study hours. Credit, 9.
Professor Mackimmie.

52. **III.** European History Since 1870. — For seniors; juniors may elect. The Franco-Prussian War and the formation of the German Empire, the unification of Italy, the Third French Republic, European Expansion in the East, the Russo-Japanese War, and the origin, events and probable results of the War of 1914. While a continuation of Course 51, this course will be complete in itself, and may be elected by those who have had no history training. Its aim is to provide the basis for an understanding of present-day conditions, and for an intelligent participation in world affairs.
3 class hours, 6 study hours. Credit, 9.
Professor Mackimmie.

Languages and Literature.

Professor Lewis, Professor Patterson, Professor Mackimmie, Professor Ashley, Assistant Professor Prince, Assistant Professor Julian, Assistant Professor Rand, Miss Goessmann, Mr. Jackson, Mr. Halliday.

English.

Required Courses.

1. **I.** 2. **II.** 3. **III.** English. — For freshmen. Composition. Intended to teach straight thinking, sound structure, clear and correct expression. Lectures, recitations, theme writing and conferences.
3 class hours, 5 study hours. Credit, 8, **I**, **II** terms.
3 class hours, 6 study hours. Credit, 9, **III** term.
Professors Patterson, Prince, Rand and Mr. Jackson.

25. **I.** 26. **II.** 27. **III.** English. — For sophomores. A general reading course in English literature.
2 class hours, 4 study hours. Credit, 6.
Professor Patterson and Miss Goessmann.

28. **I.** 29. **II.** 30. **III.** English. — English composition, oral and written.
1 class hour, 2 study hours. Credit, 3.
Professors Patterson, Prince, Rand and Mr. Jackson.

Elective Courses in English Language and Literature.

50. **I.** English Poetry of the Romantic Period (1925–26). — Alternates with Course 53. For juniors; seniors may elect. A course in history, appreciation and understanding. Some of the writers studied are Gray, Goldsmith, Burns, Scott, Wordsworth, Coleridge, Byron, Keats and Shelley.
3 class hours, 6 study hours. Credit, 9.
Professor Patterson.

51. **II.** English Poetry in the Nineteenth Century (1924–25). — Alternates with Course 54. For juniors; seniors may elect. In general, this course is like Course 50. Tennyson, Browning, Mrs. Browning, Arnold, Clough, the Rossettis, Morris, Swinburne and others.
3 class hours, 6 study hours. Credit, 9.
Professor Lewis.

57. **III.** English Poetry in the Nineteenth Century (1924–25). — Alternates with Course 58. For juniors; seniors may elect. As stated under Course 51.
3 class hours, 6 study hours. Credit, 9.
Professor Lewis.

52. **III.** English Writers from Milton to Pope. — For juniors; seniors may elect. A survey course that emphasizes the leading writers, literary currents and the thought of the period. Some of the writers studied are Milton, Dryden, Addison, Swift and Pope.
3 class hours, 6 study hours. Credit, 9.
Professor Patterson.

53. **I.** English Prose of the Romantic Period (1924–25). — For juniors; seniors may elect. A course in English prose paralleling Course 50. Some of the writers studied are Goldsmith, Coleridge, Lamb, DeQuincey and Hazlitt.
3 class hours, 6 study hours. Credit, 9.
Professor Patterson.

54. **II.** English Prose in the Nineteenth Century (1925–26). — For juniors; seniors may elect. Parallels Course 51. Among the writers considered will be Macaulay, Carlyle, Ruskin, Newman and Arnold.
3 class hours, 6 study hours. Credit, 9.
Professor Lewis.

58. **III.** English Prose in the Nineteenth Century (1925–26). — For juniors; seniors may elect. As stated under Course 54. Alternates with Course 57.
3 class hours, 6 study hours. Credit, 9.
Professor Lewis.

55. **II.** American Literature. — For juniors; seniors may elect. A course in the chief American prose writers; among those studied being Franklin, Brockden, Brown, Irving, Cooper, Poe, Hawthorne, Emerson, Thoreau, Lowell, Holmes, Parkman.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Prince.

56. **III.** American Literature. — For juniors; seniors may elect. A course in the chief American poets; among those studied being Freneau, Bryant, Poe, Emerson, Longfellow, Whittier, Holmes, Lowell, Whitman, Lanier.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Prince.

60. **I.** The Literature of Rural Life. — For juniors; seniors may elect. A critical and appreciative study of writers, both in prose and poetry, who have interpreted nature from the viewpoint of the lover of country life, and those who have idealized agriculture, horticulture and other rural pursuits, together with those who have upheld as an ideal the development of a rural environment in cities.
3 class hours, 3 study hours. Credit, 6.
Miss Goessmann.

61. **II.** The Literature of Rural Life. — For juniors; seniors may elect. As stated under Course 60.
3 class hours, 3 study hours. Credit, 6.
Miss Goessmann.
Prerequisite, English 60.

65. **I.** Advanced Composition. — For juniors; seniors may elect. Advanced work in expository writing, based upon specimens by contemporary authors and upon the personal experience of the student. Particular attention is given to organization, diction and style.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Rand.

66. **II.** Advanced Composition, — For juniors; seniors may elect. The preparation of theses and similar manuscripts upon subjects selected by the student. The foundation of this course lies in an orderly accumulation of material followed by an intelligent and readable interpretation of its significance.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Rand.

67. **III.** Advanced Composition. — For juniors; seniors may elect. Work in journalistic and fictional narrative with supplementary reading.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Rand.

75. **III.** Prose Fiction. — The short story or the novel. For seniors; juniors may elect. Readings, reports and discussions. Not offered in 1924–25.
3 class hours or library equivalents.

79. **II.** Shakespeare. — For seniors; juniors may elect. A cursory survey of the origin and rise of English drama is followed by the reading of about fifteen of Shakespeare's plays, selected to indicate the evolution of the dramatist and to emphasize the various phases of his art. Every attempt is made to deepen the student's appreciation of the personalities to be found in the plays, and of the beauty of the many memorable poetic passages.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Rand.

80. **III.** Modern Drama. — For seniors; juniors may elect. This course traces the development of English drama from the time of the Restoration to the present day. The purpose of the course is to impart an intelligent and sympathetic interest in the theatre of the Twentieth Century.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Rand.

Public Speaking.

Elective Courses.

50. **I.** Argumentation. — For juniors; seniors may elect. Presents the fundamental principles of argumentation as applied to oral and written discourse, and develops in the student power to handle argument convincingly and persuasively. Lectures, discussions of leading questions of the day, practice in brief-drawing and the writing of forensics. The course is recommended for those who desire to enter the intercollegiate debates.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Prince.

51. **II.** Occasional Oratory. — For juniors; seniors may elect. A study of the principles and the practice of formal oratory; the preparation and delivery of one original oration; prescribed reading in oratory. The course is recommended for those who wish to enter the Flint Contest.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Prince.

French and Spanish.

Professor Mackimmie, Professor Ashley, Mr. Halliday.

The aim of the courses in French and Spanish is to give the student a practical knowledge of these languages for the purpose of wider reading and research, to introduce him to some of their treasures in art and science, and through the literature to acquaint him with the people. In the elementary courses as much time as possible is given to oral work, to develop a speaking, as well as a reading, knowledge of the tongue.

French.

Required Courses.

1. **I.** 2. **II.** 3. **III.** Elementary French. — For freshmen; open upon arrangement to other students. The essentials of grammar are rapidly taught and will be accompanied by as much reading as possible. Required of freshmen presenting German for entrance who do not continue that language and have not studied French.
3 class hours, 6 study hours. Credit, 9, **I, III** terms.
3 class hours, 5 study hours. Credit, 8, **II** term.
Mr. Halliday.

4. **I.** 5. **II.** 6. **III.** Intermediate French. — For freshmen; open upon arrangement to other students. Training for rapid reading. The reading of a number of short stories, novels and plays; composition, reports on collateral reading from periodicals and scientific texts in the library.
3 class hours, 6 study hours. Credit, 9, **I, III** terms.
3 class hours, 5 study hours. Credit, 8, **II** term.
Professor Ashley and Mr. Halliday.
Prerequisite, required of freshmen who present two years of French for entrance and do not take German.

Elective Courses.

25. **I.** Intermediate French. — For sophomores; open upon arrangement to other students. Training for rapid reading; the reading of a number of short stories, novels and plays; readings from periodicals and scientific texts in the library.
3 class hours, 5 study hours. Credit, 8.
Mr. Halliday.

Prerequisites, French 1, 2 and 3.

26. **II.** Intermediate French. — For sophomores; open upon arrangement to other students. As stated under Course 25.
3 class hours, 5 study hours. Credit, 8.
Mr. Halliday.

Prerequisite, French 25.

27. **III.** Intermediate French. — For sophomores; open upon arrangement to other students. As stated under Course 25.
3 class hours, 6 study hours. Credit, 9.
Mr. Halliday.

Prerequisite, French 26.

28. **I.** Advanced French. — For sophomores; open upon arrangement to other students. A reading course. Balzac's "Eugénie Brandet" and "Le Père Goriot," and other masterpieces of the nineteenth century; Brunetière's "Honoré de Balzac" and Harper's "Masters of French Literature," readings in the library and written reports.
3 class hours, 5 study hours. Credit, 8.
Professor Ashley.

Prerequisites, French 4, 5 and 6.

29. **II.** Advanced French. — For sophomores; open upon arrangement to other students. As stated under Course 28.
3 class hours, 5 study hours. Credit, 8.
Professor Ashley.

Prerequisites, French 4, 5 and 6.

30. **III.** Advanced French. — For sophomores; open upon arrangement to other students. General view of the history of French literature; Kastner and Atkins' "History of French Literature." Representative works of the important periods. Outside reading.
3 class hours, 6 study hours. Credit, 9.
Professor Ashley.

Prerequisites, French 25 and 26, or French 28 and 29.

50. **I.** Scientific French. — For juniors; seniors may elect. Meets the requirements of individual students and equips them with exact English equivalents for the French scientific terms in their particular science. Word lists of scientific terms are required, and also weekly readings and reports from scientific works in the subject in which they are majoring. Several scientific works are read.
3 class hours, 6 study hours. Credit, 9.
Mr. Halliday.

Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

51. **II.** Scientific French. — For juniors; seniors may elect. As stated under Course 50.
3 class hours, 6 study hours. Credit, 9.
Mr. Halliday.

Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

52. **III.** Scientific French. — For juniors; seniors may elect. As stated under Course 50.
3 class hours, 6 study hours. Credit, 9.
Mr. Halliday.

Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

75. **I.** French Literature. — For seniors; juniors may elect. The object of Courses 75, 76 and 77 is to give an introduction to recent movements in French

literature. Course 75 deals with the drama, and plays by Augier, A. Dumas *fils*, Delavigne and other contemporary dramatists.
2 class hours, 4 study hours. Credit, 6.
Professor Mackimmie.
Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

76. **II.** French Literature. — For seniors; juniors may elect. The novel. Works by Flaubert, the De Goncourts and Zola are read. Written reports are required on outside reading.
2 class hours, 4 study hours. Credit, 6.
Professor Mackimmie.
Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

77. **III.** French Literature. — For seniors; juniors may elect. Modern criticism. Sainte-Beuve, "Causeries du Lundi" (Harper), and works by Taine and Renan. Reference book, Lanson's "Histoire de la Littérature Française."
2 class hours, 4 study hours. Credit, 6.
Professor Mackimmie.
Prerequisites, French 4, 5 and 6, or French 25, 26 and 27.

Spanish.

Elective Courses.

50. **I.** Elementary Spanish. — For juniors; seniors may elect. Open to other students upon arrangement. Grammar, with special drill in pronunciation; exercises in conversation and composition. Reading from a reader and selected short stories.
3 class hours, 6 study hours. Credit, 9.
Professor Ashley.

51. **II.** Elementary Spanish. — For juniors; open to other students upon arrangement. As stated in Course 50.
3 class hours, 6 study hours. Credit, 9.
Professor Ashley.
Prerequisite, Spanish 50.

52. **III.** Elementary Spanish. — For juniors; open to other students upon arrangement. As stated in Course 50.
3 class hours, 6 study hours. Credit, 9.
Professor Ashley.
Prerequisite, Spanish 51.

75. **I.** Modern Spanish Authors. — For seniors. Reading from modern Spanish novel and drama. Translation of English into Spanish. Private reading.
2 class hours, 4 study hours. Credit, 6.
Professor Mackimmie.
Prerequisite, Spanish 52.

76. **II.** Modern Spanish Authors. — For seniors. As stated in Course 75.
2 class hours, 4 study hours. Credit, 6.
Professor Mackimmie.
Prerequisite, Spanish 75.

77. **III.** Modern Spanish Authors. — For seniors. As stated in Course 75.
2 class hours, 4 study hours. Credit, 6.
Professor Mackimmie.
Prerequisite, Spanish 76.

German and Music.

Professor Ashley, Assistant Professor Julian.

German.

The courses in German are intended to give the student a reading knowledge of the language and to introduce to him some of the masterpieces of German literature. To the student interested in pursuing advanced reading in scientific German, opportunity is given to do corollary reading in his major subject, in collaboration with the head of that department.

Required Courses.

1. **I.** 2. **II.** 3. **III.** Elementary German. — For freshmen; open upon arrangement to other students. Grammar, composition and reading. Especial attention is given to oral work in German and to translation of English into German. Required of those presenting French for entrance who do not continue that language and have not studied German.
3 class hours, 6 study hours. Credit, 9, **I, III** terms.
3 class hours, 5 study hours. Credit, 8, **II** term.
Assistant Professor Julian.

4. **I.** 5. **II.** 6. **III.** Intermediate German. — For freshmen; open upon arrangement to other students. Selected works of Schiller, Heine and Goethe. Grammar review and advanced prose composition.
3 class hours, 6 study hours. Credit, 9, **I, III** terms.
3 class hours, 5 study hours. Credit, 6, **II** term.
Assistant Professor Julian.

Prerequisite, required of freshmen who present two years of German for entrance and do not take French.

Elective Courses.

25. **I.** Intermediate German. — For sophomores; open upon arrangement to other students. Reading of such works as Sudermann's "Frau Sorge," "Wilhelm Tell," "Die Journalisten," etc. Grammar review.
3 class hours, 5 study hours. Credit, 8.
Assistant Professor Julian.

Prerequisites, German 1, 2 and 3.

26. **II.** Intermediate German. — For sophomores; open upon arrangement to other students. As stated under Course 25.
3 class hours, 5 study hours. Credit, 8.
Assistant Professor Julian.

Prerequisite, German 25.

27. **III.** Intermediate German. — For sophomores; open upon arrangement to other students. As stated under Course 25.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Julian.

Prerequisite, German 26.

28. **I.** Advanced German. — For sophomores; open upon arrangement to other students. Reading and studying of Goethe's most important literary productions.
3 class hours, 5 study hours. Credit, 8.
Professor Ashley.

Prerequisites, German 4, 5 and 6.

29. **II.** Advanced German. — For sophomores; open upon arrangement to other students. Development of the German novel; rapid reading of great novelists.
3 class hours, 5 study hours. Credit, 8.
Professor Ashley.

Prerequisite, German 28.

30. **III.** Advanced German. — For sophomores; open upon arrangement to other students. As stated under Course 29.
3 class hours, 6 study hours. Credit, 9.
Professor Ashley.

Prerequisite, German 29.

50. **I.** Scientific German. — For juniors; seniors may elect. Reading in German of modern magazine articles and works of a scientific nature. Different work assigned according to needs of individual students.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Julian.

Prerequisites, German 4, 5 and 6, or German 25, 26 and 27.

51. **II.** Scientific German. — For juniors; seniors may elect. As stated under Course 50.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Julian.

Prerequisite, German 50.

52. **III.** Scientific German. — For juniors; seniors may elect. As stated under Course 50.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Julian.

Prerequisite, German 51.

75. **I.** German Literature. — For seniors. Advanced language and literary study. Conducted entirely in German. Lectures on German literature and history; life, customs and travel in Germany. Collateral readings, including masterpieces of different epochs, such as "Niebelungenlied," Goethe's "Faust" and one modern typical drama.
3 class hours, 6 study hours. Credit, 9.
Professor Ashley.

Prerequisites, German 28, 29 and 30.

76. **II.** German Literature. — For seniors. As stated under Course 75.
3 class hours, 6 study hours. Credit, 9.
Professor Ashley.

Prerequisite, German 75.

77. **III.** German Literature. — For seniors. As stated under Course 75.
3 class hours, 6 study hours. Credit, 9.
Professor Ashley.

Prerequisite, German 76.

78. **I.** Conversation and Composition. — For seniors; juniors may elect. Translating connected English into German. Reproducing outside readings in German orally in class.
1 class hour, 2 study hours. Credit, 3.
Professor Ashley.

Prerequisites, German 4, 5 and 6, or German 25, 26 and 27.

79. **II.** Conversation and Composition. — For seniors; juniors may elect. As stated under Course 78.
1 class hour, 2 study hours. Credit, 3.
Professor Ashley.

Prerequisite, German 78.

80. **III.** Conversation and Composition. — For seniors; juniors may elect. As stated under Course 78.
1 class hour, 2 study hours. Credit, 3.
Professor Ashley.

Prerequisite, German 79.

Music.

Elective Courses.

50. **I.** History and Interpretation of Music. — For juniors; seniors may elect. History of music among the ancients; medieval and secular music; epoch of vocal counterpoint; development of monophony opera and oratorio; life and works of the greatest representatives of the classical school, — Bach, Händel, Haydn, Gluck and Mozart.
1 class hour, 2 study hours. Credit, 3.
Professor Ashley.

51. **II.** History and Interpretation of Music. — For juniors; seniors may elect. A continuation of Course 50. The Romantic school; Beethoven, Schubert, Weber, Mendelssohn, Schumann, Chopin, Berlioz and Liszt; Wagner and the opera.
1 class hour, 2 study hours. Credit, 3.
Professor Ashley.

52. **III.** History and Interpretation of Music. — For juniors; seniors may elect. The Modern school and Modern composers.
1 class hour, 2 study hours. Credit, 3.
Professor Ashley.

DIVISION OF RURAL SOCIAL SCIENCE.

[Heavy-faced type indicates the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

Agricultural Economics.

Professor Cance, Assistant Professor Sawtelle, Mr. Yount, Mr. Smart.[1]

Instruction in agricultural economics is designed to show that the agricultural industry justified its existence chiefly as a supplier of food and raw textile materials for human consumption; that agricultural success is measured by production of values rather than by production of volume of agricultural products; that the goal of the farmer is the largest net profit over a long-time period; that agricultural production includes all processes from purchase of seed and fertilizer and preparation of seedbed until the product reaches the consumer, including collection, transportation, storage, financing, packing, handling and selling; that a knowledge of the business of agriculture and agricultural commerce is to-day more necessary than a knowledge of agricultural technique.

The work of this department is conducted by means of lectures, readings and research in both library and field. A catalogue, now containing some 12,000 cards, covering the various phases of agricultural economics, is maintained. The department is also supplied with a large collection of maps, charts and statistical reports on the prices and supply of agricultural products. A goodly number of

[1] Temporary.

regular reports of the Bureau of Markets and other divisions of the United States Department of Agriculture are available for the use of students. Two series of bound volumes of bulletins are kept in the department offices, with duplicate series in the college library; one series already contains 12 volumes on "Co-operation in Agriculture," and the other, 15 volumes on "Marketing of Farm Products."

Required Courses.

26. **II.** Agricultural Industry and Resources. — For sophomores. A descriptive course dealing with agriculture as an industry and its relation to physiography, movement of population, supply of labor, commercial development, transportation, public authority and consumers' demand. The principal agricultural resources of the United States are studied with reference to commercial importance, geographical distribution, present condition and means of increasing the value of the product and cheapening cost of production. Lectures, assigned readings, class topics and discussions.
4 class hours. 1 2-hour laboratory period, 6 study hours, credit, 12.
Mr. Yount.

Elective Courses.

50. **I.** Elements of Agricultural Economics. — For juniors; seniors may elect. This course is designed to accompany or follow the course in elements of economics. It deals with the economic principles underlying the welfare and prosperity of the farmer and those institutions upon which his economic success depends; the economic elements in the production and distribution of agricultural wealth; means of exchange; principles of rural credit; problems of land tenure and land values; taxation of farm property; and the maintenance of the economic status of the farmer. Lectures, text, readings, topics and field work.
5 class hours, 7 study hours. Credit, 12.
Professor Cance.

51. **III.** The Evolution of Agriculture. — For seniors; juniors may elect. A general survey of the evolution of the agricultural industry. Significant developments are traced and their causes and consequences studied. An attempt is made to give the student a knowledge of the changes which have taken place and which are taking place in the agricultural industry, the conditions which accompany these changes, and to furnish a basis by which the significance and the course of present and future developments in agriculture may be judged. Special emphasis will be placed on the development of agriculture in New England and the United States. Lectures, readings and library work.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Sawtelle.

52. **II.** Co-operation in Agriculture. — For juniors; seniors may elect. The history, principles and business relations of agricultural co-operation. (1) A survey of the development, methods and economic results of farmers' organizations and great co-operative movements; (2) the business organization of agriculture abroad, and the present aspects and tendencies in the United States; (3) the principles underlying successful co-operative endeavor among farmers, practical working plans for co-operative associations, with particular reference to purchase of supplies and the marketing of perishable products. Lectures, text, assigned readings and practical exercises.
5 class hours, 7 study hours. Credit, 12.
Professor Cance.

53. **III.** The Agricultural Market. — For juniors; seniors and graduate students may elect. A study of the forces and conditions which determine the prices of farm products and the mechanism, methods and problems concerned with transporting, storing and distributing them. Supply and demand, course

of prices, terminal facilities, the middleman system, speculation in agricultural products, protective legislation, the retail market and direct sales are taken up. The characteristics and possibilities of the New England market are given special attention. Lectures, readings, assigned studies and field work.
5 class hours, 7 study hours. Credit, 12.
Professor Cance.

75. **II.** Rural and Business Law. — For seniors; juniors may elect. Land, titles, public roads, rights incident to ownership of livestock, contracts, commercial paper and distinctions between personal and real property. Text, written exercises, lectures and class discussions.
5 class hours, 7 study hours. Credit, 12.
Mr. Smart.

76. **II.** Transportation of Agricultural Products. — For seniors and graduate students; juniors may elect. The development of highway, waterway and railway transportation and its relation to the agricultural development of the country; the principles governing the operation and control of transportation agencies; present-day problems relating to the shipment of farm products, rates, facilities and services; methods of reducing wastes in transportation; the economics of the good roads movement and of motor transportation. Lectures, text and field work.
5 class hours, 7 study hours. Credit, 12.
Professor Cance.

77. **I.** Problems in Agricultural Economics. — For seniors and graduate students; juniors may elect. An advanced course for those desirous of studying more intensively some of the economic problems affecting the farmer, such as: land problems, — land tenure, size of farms, causes affecting land values, private property in land, taxation of farm property; special problems, — cost of producing farm products, farm labor in New England, immigration, agricultural credit. Opportunity is given, if practicable, for field work, and students are encouraged to pursue lines of individual interest.
5 class hours, 7 study hours. Credit, 12.
Professor Cance.

78. **III.** Agricultural Credit Facilities. — For seniors and juniors. Lectures, discussions and assigned readings on credit needs of farmers; the legitimate use of credit in the acquisition of land, and the production, storage and marketing of agricultural products; the development of national and State rural credit institutions and laws; the powers and methods of operation of credit institutions with reference to the supply of credit for agricultural purposes; the methods by which the individual may increase his credit standing and borrowing power; ways in which the present credit facilities may be increased.
3 class hours, 6 study hours. Credit, 9.
Assistant Professor Sawtelle.

79. **I.** Agricultural Statistics. — For seniors, juniors and graduate students. The nature and sources of agricultural statistics, the methods of obtaining numerical facts, of analyzing and drawing conclusions from statistical data, and the methods of presenting in a true and forceful manner the statistical facts of the agricultural industry. Opportunity is given in the laboratory for practice in the use of statistical methods and processes, and to acquire experience in dealing with practical statistical problems. The application of statistics and statistical methods in the fields of agricultural economics, extension work, education, journalism and the business matters connected with farm operation is emphasized.
2 class hours. 3 2-hour laboratory periods, 4 study hours, credit, 12.
Assistant Professor Sawtelle.

80. **I.** SEMINAR. — For seniors and graduate students. Research in agricultural economics and history; problems of New England agriculture. Library work and reports. If desirable some other topic may be substituted.
1 or 2 2-hour conference periods, 1 or 2 study hours, credit, 3 or 6.
The DEPARTMENT.

81. **II.** SEMINAR. — For seniors and graduate students. As stated in Course 80.
1 or 2 2-hour conference periods, 1 or 2 study hours, credit, 3 or 6.
The DEPARTMENT.

82. **III.** SEMINAR. — For seniors and graduate students. As stated in Course 80.
1 or 2 2-hour conference periods, 1 or 2 study hours, credit, 3 or 6.
The DEPARTMENT.

83. **I.** SALESMANSHIP OF AGRICULTURAL PRODUCTS. — For seniors; juniors may elect. The course embraces a study of the principles and practices that are involved in the selling of goods and services. The application of these principles of salesmanship to the disposal of agricultural products is especially emphasized. Types of sales, motives for buying, securing interviews, types of prospects, preparation of sales talks, meeting objections and excuses, and sales demonstrations by students and the instructor are included.
2 class hours, 4 study hours. Credit, 6.
Mr. YOUNT.

84. **III.** ADVERTISING AGRICULTURAL PRODUCTS. — For seniors; juniors may elect. A course dealing with the application of the principles of advertising to agricultural products. A study of the nature of advertising, the economics of advertising, the use of media, copy, psychology as applied to advertising, layout, the advertising campaign, advertising agency, etc., is made. The solution of practical problems to emphasize different phases of advertising is required by students.
2 class hours, 4 study hours. Credit, 6.
Mr. YOUNT.

85. **II.** AGRICULTURAL PRICES. — For seniors and graduate students. A study of the prices of agricultural products and other commodities which are of importance in the agricultural industry. Limited to five students.
2 or 3 2-hour laboratory periods, 2 or 3 study hours, credit, 6 or 9.
Assistant Professor SAWTELLE.

86. **III.** AGRICULTURAL PRICES. — For seniors and graduate students as stated in Course 85. Limited to five students.
2 or 3 2-hour laboratory periods, 2 or 3 study hours, credit, 6 or 9.
Assistant Professor SAWTELLE.

87. **III.** FOREIGN TRADE IN AGRICULTURAL PRODUCTS. — For seniors and graduates; juniors may elect. A general course embracing a study of the principles and practices of international trade and the foreign commerce of the United States, particularly with reference to agricultural products. The development and present status of foreign trade in agricultural products, trade relations with foreign nations, the agencies and practices of foreign trade, foreign trade salesmanship and advertising, the status of New England with reference to foreign trade are some of the topics which will be presented. The work in the course will also include a personal study of special features of foreign trade and of the trade importance of specific subjects. Textbook, class discussions and class topics.
3 class hours, 6 study hours. Credit, 9.
Mr. YOUNT.

Agricultural Education.

Professor WELLES, Professor GLICK, Mr. HEALD.[1]

The primary aim of the department is to train students for service in some form of educational work. Students desiring state approval as teachers of agriculture or related subjects should confer with the head of the department as early as possible to insure a desirable range of preparation. They should also become acquainted with the State Agent for Agricultural Teacher-Training who approves candidates for positions in agricultural departments and special schools.

The department seeks to be of the greatest possible service to students who are prepared to teach and whose scholastic standing and qualifications generally seem to make them suitable candidates for positions. Students who major in other departments but expect to teach should consult this department regarding the educational courses best suited to their purposes.

The department recommends to the State Department of Education such graduates of the college as are entitled to receive the high school teachers' term certificate.

The department is thoroughly equipped for its work with classrooms, reference material, etc.

29. **II.** PROBLEMS IN EDUCATION. — For sophomores in the Division of Rural Social Science. The aim of this course is to awaken young students to the fact that what they enjoy in educational opportunities has not always existed. Our American educational policy and program is the present form of the solution of many vital problems of education. These are continually facing the newer generations as industry and living conditions change. Thinking men and women tomorrow must give attention to so vital a concern in life as education and should begin early. The work covers text, references, discussions and lectures.
3 class hours, 3 study hours. Credit, 6.
Professor WELLES.

51. **I** and **II.** PRINCIPLES AND METHODS OF TEACHING. — For juniors; seniors may elect. This course is intended for students who expect to teach. Others must consult the head of the department before registering. The study covers the general principles and methods of teaching and their application to particular cases. This is an adaptation of the case plan of study. Discussions of the classroom are very important. Outside reading is required on assigned and optional matter. Observation visits to schools in session are required with full reports. Each student must prepare a lesson for teaching and teach a moot class subject to the critical analysis of the class and the instructor. A good text is the basis of the course.
5 class hours, 5 study hours. Credit, 10.
Professor WELLES.

52. **III.** HISTORY AND PHILOSOPHY OF EDUCATION. — For juniors; seniors and graduates may elect. A general course in the history of educational theory and practice. Special emphasis is placed upon the philosophical background of education.
5 class hours, 7 study hours. Credit, 12.
Professor GLICK.
Prerequisite, Agricultural Education 55 or the consent of the instructor.

55. **I** and **II.** GENERAL PSYCHOLOGY. — For juniors; seniors and graduates may elect. This is a basic course for those anticipating further study in psychology as well as a practical and cultural course for those who can take only one course in this field. It deals with the fundamental principles of psychology; the evolu-

[1]State Agent for Agricultural Teacher-Training representing the State Department of Education in the administration of vocational education acts.

tion of mind in animals and man; various types and products of social organizations; abnormal psychology including hypnotism, dreams, mental disorders, etc.
5 class hours, 5 study hours. Credit, 10.
Professor Glick.

56. **II** and **III**. Educational Psychology. — For juniors; seniors and graduates may elect. It is a direct application of psychology to the field of education and is a basic course for both general and specific methods. The course deals with the original nature of the child, the psychology of learning, individual differences, transfer of training, mental tests, etc. Intended primarily for prospective teachers, but open to others who are sufficiently interested.
5 class hours, 5 study hours. Credit, 10.
Professor Glick.
Prerequisite, Agricultural Education 55 or consent of the instructor.

75. **II**. Principles of Secondary Education. — For seniors; juniors may elect. This is a study of the American high school, both junior and senior. It is designed to acquaint the student with the aims and objectives of the high school and the factors upon which the realization of these aims depend. Some of the specific topics included in the study are financial support, course of study, qualifications of teachers and recent tendencies and policies in secondary education.
3 class hours, 3 study hours. Credit, 6.
Professor Glick.

76. **I** and **III**. Special Methods in Teaching Agriculture and Related Science. — For seniors; juniors and others qualified may elect. Owing to the specialized nature of this course, the head of the department must be consulted before registration. The course aims to set out clearly the main details in teaching agriculture and related science from a vocational point of view. The home project is considered the basis. The work covers material and method, laws, policies, state requirements, common practices, teachers' subject and method outlines, project outlines, lesson plans, moot class teaching, observation, references, weekly oral and written reports, etc. The principle of job analysis is employed throughout the course.
3 class hours. 3 laboratory hours, 4 study hours, credit, 10.
Professor Welles.

77. **III**. Methods in Extension Teaching. — For seniors; juniors and others qualified may elect. The nature of this course requires that only those who are definitely interested be admitted. Candidates must consult the head of the department before registering. The course consists of a survey of the field of extension work and the methods by which this work is accomplished. The specific lines dealt with are those of the county agent, boys' and girls' club leader, county demonstration agent and agricultural specialist. The administration of county, state and federal extension service is included in the discussions. Some time will be required of each student in field observation of extension work. The course will be conducted jointly by members of the Extension Service staff and the department of Agricultural Education.
3 class hours, 3 study hours. Credit, 6.
Professor Welles and Extension Service Staff.

80. **I**, **II** and **III**. Supervised Teaching. — (Includes apprentice, practice and observation teaching.) Primarily for seniors; juniors and others qualified may be admitted by arrangement. Under certain conditions a student may absent himself from college during one term of his junior or senior year for supervised teaching. Such a procedure is particularly desired for those who are preparing to teach agriculture and is in accordance with the state plan which specifies the apprentice method of training. For detailed information, consult the head of the department.

Opportunities for practice teaching are sought on the campus and in nearby high schools for those who cannot absent themselves for a term of apprentice teaching. A limited amount of observation practice is permissible. Besides teaching, a student is required to pursue a course of professional reading bearing upon the subject he is teaching or observing. In all cases he is required to make detailed teaching plans covering the subject-matter of the lessons and to outline the supporting projects. The amount of credit depends upon the number, character and length of teaching exercises and conferences. Scheduled by arrangement.
1 class hour. 1 to 5 laboratory hours, 1 to 5 study hours, credit, 3 to 11.
The Department.

81. **III.** Seminar in Methods of Teaching. — Open to seniors majoring in Agricultural Education; graduate students and others by arrangement. This is an opportunity for those definitely intending to teach to make further studies in special lines other than agriculture, which is provided for in Agricultural Education 76. These include methods in college teaching, special methods in science, etc.
1 2-hour conference period, 1 to 3 study hours, credit, 3 to 5.
Professor Welles.
Prerequisites, Agricultural Education 51 and 56 or equivalents.

83. **III.** Seminar in Applied Psychology. — For seniors and graduates. Intended for those who desire to study the application of psychology in special fields such as salesmanship, advertising, medicine, law, public office, extension work, education, business, etc.
1 2-hour conference period, 1 to 3 study hours, credit, 3 to 5.
Professor Glick.
Prerequisites, Agricultural Education 55 and 56 or 85.

85. **I.** Vocational Psychology. — For seniors and graduates. A study of psychology as applied to vocational work other than education. Emphasis is placed upon the theory and use of vocational tests, selection of men, individual aptitudes, etc.
3 class hours, 3 study hours. Credit, 6.
Professor Glick.
Prerequisite, Agricultural Education 55 or consent of the instructor.

Rural Sociology.

Professor ——, Professor Sims.[1]

The courses in rural sociology are designed for two purposes: first, to give students an appreciation of the general problems of country life; second, to afford a definite training for students who wish to take up some specific form of social service. In the last ten years rural sociology has been introduced as a subject into more than 50 per cent of the agricultural schools and colleges. There is a good demand for teachers, and an increasing opportunity in other directions in this subject. The courses afford the student an opportunity to pursue graduate as well as undergraduate work. The library of the college is unusually well equipped with rural sociological material.

Required Course.

27. **III.** Elements of Rural Sociology. — For sophomores. A broad survey of the field of rural sociology, including such topics as the origin of rural sociology, its methods and problems; relation of sociological to the scientific and technical aspects of agricultural problems; the development of the rural community in New England and the west, religious, educational and social ideals of rural people; characteristics and influence of the rural environment, the movement of the rural

[1] Absent on leave.

population, the effects of immigration; rural institutions, the school, the church, local government, effects of modern conditions of life on rural institutions; rural organization; problems of progress, an analysis of the needs of rural life in its further development. Lectures, readings and essays on assigned topics.

3 class hours, 6 study hours. Credit, 9.

Professor Sims.

Elective Courses.

50. **I.** Rural Village and Town Sociology. — For juniors; seniors may elect. Village history and evolution; present status and importance of the small town; its relation to farm and city; institutional, economic, social, cultural and moral aspects; the problems of citizenship, organization and leadership presented by the small town; schemes for improvement criticized and evaluated. This course has special value for New Englanders who wish to understand their semi-urban and town communities. Lectures, discussions and topical reports.

3 class hours, 6 study hours. Credit, 9.

Professor Sims.

51. **II.** Rural Government. — For juniors; seniors may elect. A general survey of the development of rural government in the United States, origin of the New England town, its influence upon the west, county government, the influence of the farmer in legislation, good roads movement, credit facilities, taxation, boards of agriculture, agricultural colleges and experiment stations in relation to rural welfare; national government; a general survey of political organizations and movements among farmers in the United States and foreign countries and their influence in shaping legislation; relation of the Department of Agriculture, postal system, the various national commissions and agencies to rural welfare. Lectures, readings, written exercises on assigned topics.

3 class hours, 6 study hours. Credit, 9.

Professor Sims.

52. **III.** Rural Organization. — For juniors; seniors may elect. A study of the organized agencies by which rural communities carry on their various forms of associated life, particularly a study of the ways by which the domestic, economic, cultural, religious and political institutions contribute to rural betterment; principles underlying leadership, qualifications of the paid leader and the lay leader; the field of rural social service, national, State and local, preparation and opportunity for service; rural community building, a study of organized ways and means by which aid is given local communities. The method, scope and history of local, State and national associations formed about some farm product, their influence in forming class consciousness and in shaping agrarian legislation; need of federation. Lectures, readings and essays on assigned topics.

3 class hours, 6 study hours. Credit, 9.

Professor Sims.

76. **I.** Field Work in Rural Sociology. — For seniors; juniors may elect. Designed to meet the needs of students who wish to do some constructive work in rural social service while still in college. The work is carried on in co-operation with the various college agencies engaged in rural service. Any project for which credit in this course is to be asked must first have the approval of the head of the department.

2 to 6 laboratory hours, credits, 2 to 6.

Professor Sims.

Prerequisites, Rural Sociology 27 and preferably 50 or 52.

77. **II.** Rural Social Research and Surveys. — For seniors and juniors. A careful study is made of the scientific method as applied to social problems, the technique of investigation and research; the procedure of gathering sociological

data by means of the survey; the interpretation and graphic presentation of statistical facts. This course is indispensable for those contemplating any kind of social work. Text, lectures, and laboratory work.
3 class hours, 6 study hours. Credit, 9.
Professor SIMS.

79. **I.** SEMINAR. — Enrollment is open to seniors, students majoring in rural sociology and others especially prepared.
1 to 3 class hours, 2 to 6 study hours. Credit, 3 to 9.
Professor SIMS.

80. **II.** SEMINAR. — Enrollment is open to seniors, students majoring in rural sociology and others especially prepared.
1 to 3 class hours, 2 to 6 study hours. Credit, 3 to 9.
Professor SIMS.

81. **III.** SEMINAR. — Enrollment is open to seniors, students majoring in rural sociology and others especially prepared.
1 to 3 class hours, 2 to 6 study hours. Credit, 3 to 9.
Professor SIMS.

Rural Home Life.

Professor SKINNER, Assistant Professor KNOWLTON, Miss BARTLEY.

The emphasis of the work in Home Economics is upon home making as a fundamental vocation. To this end, not only technical courses are offered, but also those which will tend to give the student a better understanding of the place which the home should take as a factor in community life, and a sympathetic attitude toward the problems of every day life.

The work is largely prescribed in the first two years and gives the necessary basis for the development of courses in Home Economics during the junior and senior years. It is possible for graduates of this course, if they have skillfully chosen their electives in the field of agriculture or horticulture, to engage in home industries for profit and to engage in certain phases of professional work in the field of Home Economics.

The food laboratory located in Fernald Hall is fitted with individual cabinets and gas stoves. Provision is made for practice in the preparation and serving of meals with the family as a unit. The clothing laboratory located in the Abigail Adams House is provided with modern equipment. The related science is given in the laboratories of the various departments of the college.

1. **I.** INTRODUCTION TO HOME ECONOMICS. — For freshmen. Lectures on the history and evolution of the home; social customs and their value in family relationships; healthful and suitable care of the wardrobe; principles of nutrition as applied to the student's life; the student's budget, and the keeping of personal accounts.
2 class hours. Credit, 2.
Miss SKINNER.

28. **I.** 29. **II.** CLOTHING AND TEXTILES. — For sophomores. A study of the selection and purchase of suitable materials, their character and cost; appropriateness and simplicity in dress. Practical laboratory work includes designing and drafting of patterns, the use of commercial patterns, and the making and repairing of garments.
2 class hours. 3 2-hour laboratory periods, 4 study hours, credit, 12.
Miss BARTLEY.

28. **III.** FOODS. — For sophomores. An introduction to the study of foods; selection, preparation and service.
2 class hours. 3 2-hour laboratory periods, 4 study hours, credit, 12.
Miss KNOWLTON.

50. **I.** Foods. — For juniors. A study of foods in their scientific and economic aspects, with the preparation of simple breakfasts and luncheons.
2 class hours. 3 2-hour laboratory periods, 4 study hours, credit, 12.
Miss Knowlton.

51. **II.** Foods. — For juniors. A further study of foods on the basis of meal planning in the home, with especial emphasis on dinners and the day's meals as a whole.
2 class hours. 2 3-hour laboratory periods, 4 study hours, credit, 12.
Miss Knowlton.

52. **III.** Dietetics. — For juniors. A study of the food requirement throughout infancy, childhood, adolescence, adult life and old age, considering the energy value of foods and the nutritive properties of foodstuffs. Typical dietaries are planned for each period, with special regard to economic and social conditions.
2 class hours. 3 2-hour laboratory periods, 4 study hours, credit, 12.
Miss Knowlton.

53. **I.** (Rural Engineering 53) House Planning and Construction. — For juniors. A study of the common building materials and their use in house construction. The principles of house planning will be studied and plan designs originated, consideration being given to such problems as heating, lighting, water supply and sewage disposal. The economics of house building, including financing, maintenance and overhead expense, will also be studied.
2 class hours. 2 2-hour laboratory periods, 2 study hours, credit, 8.
Miss Skinner and Assistant Professor Strahan.

56. **I.** Clothing. — For juniors. This course aims to develop initiative, independence and art in designing garments for figures of different types, with special emphasis on proportion, color and texture. Laboratory work will be concerned with more difficult problems of garment construction.
2 class hours. 3 2-hour laboratory periods, 4 study hours, credit, 12.
Miss Bartley.

76. **II.** Household Management. — For seniors. The application of the principles of scientific management to the household, and the elements of successful home making. The family income, cost of living, household accounts, the budget and its apportionment. The responsibility of the woman to her family and the community in establishing right standards of living.
4 class hours, 5 study hours. Credit, 9.
Miss Skinner.

78. **III.** Home Nursing. — For seniors. A study of the care of the family health; simple diseases and their prevention; the care of young children and invalids; first aid to the injured.
3 class hours, 4 study hours. Credit, 7.
Miss Skinner.

81. **I.** The Community of the Home Economics Graduate. — For seniors. This course is intended to be a practical application of Home Economics to the various social, economic, industrial and educational problems relating to the home which the Home Economics graduate may meet in any community, either as an employed worker or as a volunteer. Recommended only to those pursuing a major in Home Economics.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Miss Knowlton.

82. **II.** Health Education. — For seniors. This course is intended to show how the Home Economics graduate fits into the health program of the school,

either as a teacher or as volunteer worker. Recommended only to those pursuing a major in Home Economics.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Miss Knowlton.

83. **III.** Field Problems under Supervision. — For seniors. This course is intended to be a more intensive application of Home Economics to special community problems and to serve as a beginning of simple research work. Recommended only to those pursuing a major in Home Economics.
2 class hours. 1 2-hour laboratory period, 3 study hours, credit, 7.
Miss Knowlton.

84. **III.** Millinery. — For seniors. This course considers different types of hats, their appropriateness and becomingness, with practical work in designing frames, remodeling commercial frames, covering, trimming and renovating hats.
3 2-hour laboratory periods, credit, 6.
Miss Bartley.

GENERAL DEPARTMENTS.

[Heavy-faced type indicates the term in which the course is given. Numbering of courses: 1 to 24, inclusive, freshmen; 25 to 49, inclusive, sophomores; 50 to 74, inclusive, juniors; 75 to 99, inclusive, seniors.]

Military Science and Tactics.

Major Herman Kobbe, Cav. (D. O. L.), U. S. A.; Captain Dwight Hughes, Jr., Cav. (D. O. L.), U. S. A.; Captain Thomas Brady, Jr., Cav. (D. O. L.), U. S. A.; Technical Sergeant John J. Lee, U. S. A., Retired; Technical Sergeant James A. Warren, Cav. (D. E. M. L.), U. S. A.; and a detachment of enlisted men of the United States Army.

Under act of Congress (July 2, 1862) military instruction under a regular army officer was required in this college of all able-bodied male students. Under act of Congress June 3, 1916, as amended by act of Congress Sept. 8, 1916, there was established at this college in April, 1917, an infantry unit of the Reserve Officers' Training Corps. Following the World War and an act of Congress (July 9, 1918) the Reserve Officers' Training Corps is in operation under the regulation of the War Department, administered by the president of the college and the professor of military science and tactics.

Beginning with the fall term, 1920–21, the infantry unit of the Reserve Officers' Training Corps was converted into a cavalry unit.

The primary object of the Reserve Officers' Training Corps is to provide systematic military training at civil educational institutions, for the ultimate purpose of qualifying selected students of such institutions as reserve officers in the military forces of the United States. It is intended to attain this object during the time the students are pursuing their general or professional studies, with the least practicable interference with their civil careers, by employing methods designed to fit men physically, mentally and morally for pursuits of peace as well as war.

All candidates for a degree in a four-year course must take for two years at least three hours a week of military training.

Students in their junior and senior years, who are approved by the president and the professor of military science and tactics, may take the advanced course if they so elect. The advanced course consists of at least five hours per week and a summer camp of about six weeks during the summer vacation, between the junior and senior years. Students taking this course are paid by the Federal government at a rate to be fixed by the Secretary of War, not to exceed the value of the army ration. The rate now fixed is 30 cents per day, which amounts to about $103 per year. Students graduating in the advanced course are eligible for commissions in the Officers' Reserve Corps, *but are not required to accept such commissions if offered.*

The uniform furnished to Freshmen and Sophomore (Basic Class) is of Olive Drab Woolen cloth, and is supplied by the Federal Government without cost.

The uniforms for the Junior and Senior (Advanced Class) are of Forest Green Woolen cloth fitted and especially made for the individual student. It is expected that eventually this uniform will be furnished for the Basic Class also. This uniform is also furnished without cost to the student.

The course for cavalry units of the Reserve Officers' Training Corps includes theoretical and practical instruction in all phases of cavalry work, so distributed over the four-year college course as to qualify students at the end of the freshman year as privates of cavalry; at the end of the sophomore year as non-commissioned officers of cavalry; and upon graduation as reserve officers. The instruction in this department covers cavalry drill, cavalry weapons, — *i.e.*, rifle, pistol, saber, automatic rifle and machine gun, — map reading and military sketching, minor tactics, equitation, etc. The course in equitation includes cross-country riding and instruction in polo. So far as season and weather permits, instruction is of a practical nature out of doors.

Required Courses.

1. **I.** — For freshmen. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

3 laboratory hours, 2 study hours, credit, 5.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

2. **II.** — For freshmen. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

3 laboratory hours, 2 study hours, credit, 5.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

3. **III.** — For freshmen. Theoretical and practical instruction in military science and tactics, and lectures on military subjects.

3 laboratory hours, 2 study hours, credit, 5.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

25. **I.** — For sophomores. Theoretical and practical instruction in military science and tactics, and lectures on military subjects. Equitation.

3 laboratory hours, 2 study hours, credit, 5.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

26. **II.** — For sophomores. Theoretical and practical instruction in military science and tactics, and lectures on military subjects. Equitation.

3 laboratory hours, 2 study hours, credit, 5.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

27. **III.** — For sophomores. Theoretical and practical instruction in military science and tactics, and lectures on military subjects. Equitation.

3 laboratory hours, 2 study hours, credit, 5.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

Elective Courses.

50. **I.** — For juniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects. Equitation.

5 laboratory hours, 4 study hours, credit, 9.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

51. **II.** — For juniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects. Equitation.

5 laboratory hours, 4 study hours, credit, 9.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

52. **III.** — For juniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects. Equitation.

5 laboratory hours, 4 study hours, credit, 9.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

75. **I.** — For seniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects. Equitation.

5 laboratory hours, 4 study hours, credit, 9.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

76. **II.** — For seniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects. Equitation.

5 laboratory hours, 4 study hours, credit, 9.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

77. **III.** — For seniors. Theoretical and practical instruction in military science and tactics, and lectures on military subjects. Equitation.

5 laboratory hours, 4 study hours, credit, 9.
THE PROFESSOR OF MILITARY SCIENCE AND TACTICS, and ASSISTANTS.

Physical Education and Hygiene.

Professor HICKS, Assistant Professor GORE, Mrs. HICKS, Mr. BALL, Mr. DERBY, Mr. BIKE.

The purpose of the courses offered by this department is to provide active exercise and to instruct every student how to care for his health and maintain his physical condition while carrying on his college course.

The equipment consists of the Alumni Athletic Field, which has room for two football fields, a quarter-mile cinder track with a 220 straightaway, and the baseball diamond; and also the old field for class football and baseball, two tennis courts, and the drill hall floor for basket ball. For several years the drill hall floor was used for class work in gymnastics, but its condition has become so bad that this has been discontinued. During the winter months a hockey rink is provided on the college pond.

[All undergraduate male students are given a physical examination upon entering.]

MEN.

Required Courses.

1. **I.** HYGIENE. — For freshmen. Lectures on personal hygiene.
1 class hour. Credit, 1.
Professor HICKS.

2. **I.** RECREATION. — For freshmen. Outdoor games.
2 laboratory hours, credit, 2.
The DEPARTMENT.

3. **III.** RECREATION. — For freshmen. Outdoor games.
2 laboratory hours, credit, 2.
The DEPARTMENT.

7. **I.** 8. **II.** 9. **III.** Recreation. — Military substitute for freshman men.
3 1-hour laboratory periods, credit, 3.
The Department.

25. **I.** Recreation. — For sophomores. Outdoor games.
2 laboratory hours, credit, 2.
The Department.

26. **III.** Recreation. — For sophomores. Outdoor games.
2 laboratory hours, credit, 2.
The Department.

30. **I.** 31. **II.** 32. **III.** Recreation. — Military substitute for sophomore men.
3 1-hour laboratory periods, credit, 3.
The Department.

Elective Course.

77. **III.** Training Course. — For seniors. Election by permission only. History of physical education and supervision of athletics.
2 class hours, 3 study hours. Credit, 5.
Professor Hicks.

Women.

Required Courses.

4. **I.** Recreation. — For freshmen. Outdoor games.
3 laboratory hours, credit, 3.
Mrs. Hicks.

5. **II.** Gymnastics. — For freshmen. Dancing, Swedish games, etc.
3 laboratory hours, credit, 3.
Mrs. Hicks.

6. **III.** Recreation. — For freshmen. Outdoor games.
3 laboratory hours, credit, 3.
Mrs. Hicks.

27. **I.** Recreation. — For sophomores. Outdoor games.
3 laboratory hours, credit, 3.
Mrs. Hicks.

28. **II.** Gymnastics. — For sophomores. Dancing, Swedish games, etc.
3 laboratory hours, credit, 3.
Mrs. Hicks.

29. **III.** Recreation. — For sophomores. Outdoor games.
3 laboratory hours, credit, 3.
Mrs. Hicks.

Elective Courses.

50. **II.** Gymnastics. — For juniors. Dancing, Swedish games, etc.
3 laboratory hours, credit, 3.
Mrs. Hicks.

76. **II.** Gymnastics. — For seniors. Dancing, Swedish games, etc.
3 laboratory hours, credit, 3.
Mrs. Hicks.

THE LIBRARY.

The general college library consists of all books belonging to the college, including the library of the Experiment Station and all divisional and departmental collections of books. The main collection now occupies the entire building, which was originally intended to serve the purposes of both chapel and library. A dictionary card catalogue is intended ultimately to cover all material in the general college library, which now comprises approximately 70,000 volumes, besides much unbound or paper-bound material, pamphlets, periodicals and newspapers. The library contains also some important special collections of books, amounting to several thousand volumes, not yet catalogued. Much of the constantly increasing pamphlet and periodical material, even though it is not yet comprehended in the general catalogue, is made promptly available by means of check lists, indexes, bibliographies and other library helps. Files of important periodicals make readily accessible to readers the latest contributions to the sum of human knowledge by contemporary leaders in many fields of thought and investigation. Works dealing with the sciences related to the processes and problems of agriculture are in greatest abundance, but literature, history and sociology are also well represented in our collections of books. The reading room is well supplied with encyclopedias and other general reference books, and with current numbers of an attractive list of popular and technical magazines and periodicals.

The greater part of the library material has been recently reclassified and recatalogued in accordance with a standard system, and is thereby rendered at all times directly accessible to teachers and students as well as library workers. From time to time informal lectures on the use of the library will be given to groups of students. By seminar and laboratory methods, individual students will be taught to appreciate books as essential sources of information and culture, and will be instructed in the use of the various devices common in libraries for finding what the library contains. All members of the college community have the privilege of free access to the book stacks for reference purposes, and books not specially reserved may be loaned for extra-library use for a period of two weeks.

The library is open from 8 A.M. to 9.30 P.M. on week days, and from 9 A.M. to 1.30 P.M. on Sundays while college is in session. Shorter hours prevail during vacation.

THE GRADUATE SCHOOL.

EDWARD M. LEWIS, A.M., Acting President of the College.

CHARLES E. MARSHALL, Ph.D., Director of the Graduate School and Professor of Microbiology.

GRADUATE STAFF, 1924–1925.

Acting President LEWIS, Director MARSHALL, Professors ALEXANDER, ANDERSON, BEAUMONT, CANCE, CHAMBERLAIN, CLARK, CRAMPTON, FERNALD, FOORD, GRAHAM, LINDSEY, OSMUN, PETERS, SEARS, SHAW, THAYER, TORREY, WAUGH, WELLES, WERKMAN; Mr. WATTS, Secretary.

HISTORY AND AIMS.

This college has provided study of a graduate nature for many years. The need for such training became real when agriculture was recognized as an aggregate of the many sciences involved and the many practices employed. The obsolete notion that agriculture is only farming has been replaced by the notion that farming, as such, is only one element in agriculture. The ramifications and divisions of agriculture are many; most of these call for advanced study and training to meet the exigencies of the times. No apology is, therefore, required for an attempt to fathom the scientific, economic and social intricacies of such a fundamental phase of human effort as agriculture. The value of such an undertaking is, or should be, patent to every intelligent mind familiar with the situation.

Graduate work has been available to students since 1893. At that time it was possible to qualify for the degree of master of science; later, in 1898, for the degree of doctor of philosophy; in 1913, for the professional degrees of master of agriculture and doctor of agriculture; in 1916, for the specific professional degree of master of landscape architecture.

To make the graduate work more effective and distinctive in agriculture, the graduate school was established in 1908. It has become the operating agency for the purpose of fitting graduates of this and other institutions for teaching in colleges, high schools and other public schools; for positions as government, State and experiment station specialists in farm management, dairying, livestock husbandry, poultry science, agronomy, landscape gardening, pomology, vegetable gardening and floriculture; for positions as bacteriologists, botanists, chemists, entomologists; for economists and social workers; and for numerous other positions requiring a great amount of scientific and professional agricultural knowledge, training and experience.

ORGANIZATION.

The school is based upon the department as the unit, and the apprenticeship system as the most effective means of instruction. This gives to the student individuality in treatment and an intimacy with actual conditions of work and operations. The student is assigned to an advisory committee, composed of the instructor in charge of his major subject as chairman, and instructors in charge of his minor subjects as members, which directs his graduate studies. The chairmen of all these committees together constitute the graduate staff, which controls the policy of the graduate school.

ADMISSION.

Admission to the graduate school will be granted: —

1. To graduates of the Massachusetts Agricultural College.

2. To graduates of other institutions of good standing who have received a bachelor's degree substantially equivalent to that conferred by this college.

In case an applicant presents his diploma from an institution of good standing, but has not, as an undergraduate, taken as much of the subject he selects for his major as is required of undergraduates at the Massachusetts Agricultural College, he will be required to make up such parts of the undergraduate work in that subject as the instructor in charge may consider necessary. He shall do this without credit toward his advanced degree.

Admission to the graduate school does not necessarily admit to candidacy for an advanced degree, — students holding a bachelor's degree being in some cases permitted to take graduate work without becoming candidates for higher degrees.

Applications for membership in the graduate school should be presented to the director of the school. Full statements of the applicant's previous training, of the graduate work desired, and of the amount and kind of work already done by him as an undergraduate should be submitted, together with a statement whether the applicant desires to work for a degree.

Registration is required of all students taking graduate courses, the first registration being permitted only after the student has received an authorization card from the director.

NATURE, METHODS AND REQUIREMENTS OF GRADUATE WORK.

Graduate work differs from undergraduate work in its purposes and methods. The primary aims of the instructor are emphasized in an attempt to have the student adjust himself and place himself in his environment; develop the rule of self-direction and self-instruction; acquire the power of accurate reasoning; gain proficiency and skill in his selected field of study or practice; and obtain an appreciative and discriminative insight into experimentation and original research. Methods are not devised, therefore, for attractiveness, entertainment and superficial reviews, but for the creation of initiative and profound thought, thorough acquaintance with detail, independent advance and industrious habits. Careful readings, lectures, conferences, surveys, laboratory exercises and field work are some of the agencies utilized.

All members of the graduate school are required to attend the course of lectures designed to supplement the technical work of all graduate studies. These lectures will be given once each week, and the students will be held responsible for the work.

Candidates for the degree of doctor of philosophy are required to prosecute three subjects, one of which shall be designated as the major and the others as minors. No two of these subjects may be taken in the same department. An original thesis shall be considered a part of the major subject.

Candidates for the degree of doctor of agriculture are required to select a major and such other subjects as will develop the major in its greatest intensity and comprehensiveness. Successful experience is also requisite, together with a thesis which represents a masterly survey or intimate study through accurate application of some phase of the major subject.

Candidates for the degree of master of science are required to prosecute two subjects, one of which shall be designated as a major and the other as a minor. When desirable, and approved by the Director, the minor may be made up of subjects from more than one department. The major and minor subjects may not be selected in the same department. An original thesis is considered a part of the major subject.

Candidates for the degree of master of agriculture are allowed greater privileges in the selection of subjects, but will be required to select a major and such other supporting lines of study as will be necessary to equip the individual professionally.

Candidates for the degree of master of landscape architecture will be expected to conform to the established courses of the department, and to the requirements of the department in the preparation of a thesis, as well as in actual experience outside the college.

Candidates for membership in the graduate school who do not desire to work for a degree may, with the approval of the director of the school, take more than one subject in the same department, or pursue work in several departments, if their preparation will permit. A statement of the subjects chosen must in each case be submitted to the director of the graduate school for approval. The chosen subjects must bear an appropriate relation to each other.

A working knowledge of French and German is essential to successful graduate work, and students not having this will find it necessary to acquire it as soon as possible after entering. Other modern languages may be substituted if considered more valuable.

The graduate staff reserves the privilege of recommending and allowing courses in other institutions as a part of residence instruction. Such supervision will be exercised and credit granted as are essential to the highest standards of efficiency.

THESES.

A thesis is required of each candidate for an advanced degree. It must be on a topic belonging to the candidate's major subject; must show that its writer possesses the ability to carry on constructive study; must be an actual contribution to knowledge; and possess real merit.

The thesis in its final form must be submitted to the director by May 15 of the year in which the student is to present himself for the advanced degree, and before he may take the required examination. Three complete copies are required. One of the copies is to be retained as an official copy by the director, one is to be deposited in the college library, and the third is to be retained by the department in which the thesis was prepared. The candidate for the doctor's degree must be prepared to defend at the oral examination the views presented in his thesis.

FINAL EXAMINATIONS.

For the degree of doctor of philosophy or doctor of agriculture, final examinations on the minors taken are given upon the completion of the subjects. In the major subject, a written examination, if successfully passed, is followed by an oral examination in the presence of the graduate staff.

For the degree of master of science, master of agriculture or master of landscape architecture, a final examination upon the minor taken is given upon the completion of each course, and in the major a final examination, which may be either written or oral, or both, is given over all the work by the department concerned.

DEGREES CONFERRED.

The degrees of doctor of philosophy and doctor of agriculture are conferred upon graduate students who have met the following requirements: —

1. The devotion of at least three years[1] to the prosecution of three subjects of study and research in residence at the college.
2. The earning of not less than one hundred credits in the chief or major subject, and of not less than twenty-five credits in each of two minor subjects.
3. The preparation of a thesis, in the major subject, constituting an actual contribution to knowledge and accompanied by drawings if necessary. For the degree of doctor of agriculture the thesis may be modified to meet professional requirements.
4. The passing of final examinations, in both the major and minor subjects, to the satisfaction of the instructors in charge.

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[1] All time statements refer to minimum time.

5. A public oral examination.
6. The payment of all fees and college expenses required.

The degrees of master of science, master of agriculture and master of landscape architecture are conferred upon graduate students who have met the following requirements: —

1. The devotion of at least one year and a half to the prosecution of study in two subjects of study and research, not less than one full college year of which must be in residence. In the case of a master of landscape architecture the student must follow the prescribed course of study.
2. The earning of not less than fifty credits in the chief or major subject, and of not less than twenty-five credits in the minor subject. Students pursuing the course in landscape architecture will devote all of their time to the established course, and meet the conditions of one year of experience outside the college.
3. The preparation of a thesis in the major subject, constituting an actual contribution to knowledge, and accompanied by drawings if necessary.
4. The passing of final examinations, in both major and minor subjects, to the satisfaction of the professors in charge.
5. The payment of all fees and college expenses required.

The fee for the degree of master of science, master of agriculture, or master of landscape architecture is $10, and for the degree of doctor of philosophy or doctor of agriculture, $25.

COURSES OFFERED.

Courses available as major subjects for the degree of doctor of philosophy: —

Agricultural Economics.
Agronomy.
Botany.
Chemistry.
Entomology.
Horticulture.
Microbiology.
Pomology.
Rural Sociology.

Courses available as major subjects for the degree of master of science: —

Agricultural Economics.
Agricultural Education.
Agriculture.
Agronomy.
Animal Husbandry.
Botany.
Chemistry.
Entomology.
Horticulture.
Mathematics and Physics.
Microbiology.
Pomology.
Poultry Science.
Rural Sociology.
Veterinary Science.

Courses available as major subjects for the degree of master of agriculture: —

Agronomy.
Animal Husbandry.
Poultry Science.

The course in Landscape Architecture leads to the degree of master of landscape architecture.

Courses available as minor subjects: —

Agricultural Economics.
Agricultural Education.
Agriculture.
Agronomy.
Animal Husbandry.
Animal Pathology.
Botany.
Chemistry.
Entomology.
Horticulture.
Landscape Architecture.
Mathematics and Physics.
Microbiology.
Pomology.
Poultry Science.
Rural Sociology.
Zoölogy.

GENERAL OUTLINE OF COURSES FOR ADVANCED DEGREES.

Agricultural Economics.

MAJOR REQUIREMENTS.

For the Degree of Doctor of Philosophy.

PREREQUISITE WORK. — Candidates must have had the following courses or their equivalent: Economics and Sociology 51, Agricultural Economics 26 and 50.

REQUIRED WORK. — Candidates must take the following courses: Agricultural Economics 51, 52, 53 and 79. These courses, specially arranged for graduates, may be taken as Courses 120, 170, 155 and 180 for graduate credit. In addition, candidates must take Courses 110, 111, 130, 165 and 175 in Agricultural Economics; Rural Sociology 27 and 50, or equivalent courses; and Economics and Sociology 50 and 77, or equivalent courses.

Each candidate will be required to have a working knowledge of the general field of economics, the history of agricultural economics, the theory of agricultural economics, the problems of agricultural production, land tenure, land problems, agricultural commerce, agricultural co-operation, agricultural credit, statistics of agriculture, and prices, markets and marketing.

For the Degree of Master of Science.

PREREQUISITE WORK. — The same as for the degree of doctor of philosophy.

REQUIRED WORK. — The same as for the degree of doctor of philosophy, except that there is no language requirement.

GRADUATE COURSES OFFERED.

110. THEORY OF AGRICULTURAL ECONOMICS. — Readings in French, German and English on economics of agriculture. Alternate years, odd, 200 hours.
Credits, 3.
Professor CANCE.

111. CURRENT ECONOMIC PROBLEMS AND LITERATURE. — Department seminar throughout the year. Credit, 1 each term.

120. HISTORICAL AND COMPARATIVE AGRICULTURE. — General survey. May be taken in connection with Course 51. Spring term, yearly. Credits, 3.
Assistant Professor SAWTELLE.

121–122. HISTORY OF AMERICAN AGRICULTURE. — Special studies in the history of agricultural institutions, practices or relations. Fall term, even years.
Credits, 5.
Assistant Professor JEFFERSON.

130. PROBLEMS OF AGRICULTURAL PRODUCTION. — The relation of the farmer to the food supply. May be taken in connection with Course 77. Fall term, yearly.
Credits, 5.
Professor CANCE.

140. LAND TENURE AND THE ACQUISITION OF FARM LAND. — Readings, discussion, original exercises. Alternate years, even. Credits, 3–5.
Professor CANCE.

145. FARM LABOR. — Reading and investigation. Credits, 3.
Professor CANCE.

150. Agricultural Commerce, Industry and Trade. — A study of trade movements and commercial activities relating to agricultural products. Fall term, alternate years, odd. Credits, 3–5.
Assistant Professor Jefferson.

155. The Agricultural Market. — A study of the forces, methods and institutions of the market for agricultural products. Spring term, yearly.
Credits, 5.
Professor Cance.

156. Specific Problems in Marketing Farm Products. — Reports and discussions. Alternate years, odd. Credits, 3.
Professor Cance.

160. Agricultural Prices. — Winter term, yearly. Credits, 3.
Assistant Professor Sawtelle.

161. Agricultural Prices. — Spring term, yearly. Credits, 3.
Assistant Professor Sawtelle.

165. Transportation of Agricultural Products. — Elementary discussion and report. Winter term, yearly. Credits, 5.
Professor Cance.

166. Specific Transportation Problems. — Original study, reading and report on certain transportation problems related to agriculture. Alternate years, odd.
Credits, 3–5.
Assistant Professor Sawtelle.

170. Co-operation in Agriculture. — Elementary problems and discussion. May be taken in connection with Course 50. Winter term, yearly. Credits, 5.
Professor Cance.

171–172. Special Problems in Co-operation for Economic Purposes. — Study, original investigation and discussion. Every third year, beginning 1922.
Credits, 3–5.
Professor Cance.

175. Agricultural Credit. — Readings and reports in addition to class lectures on agricultural credit. Taken in connection with Course 78. Spring term, yearly. Credits, 3–5.
Assistant Professor Sawtelle.

180. Elementary Principles of Statistics. — Chiefly related to agriculture. Lectures, laboratory studies and original work. Taken in connection with Course 79. Fall term, yearly. Credits, 5.
Assistant Professor Sawtelle.

181. Specific Problems in Statistics of Agriculture. — Alternate years, even. Credits, 3–5.
Assistant Professor Sawtelle.

185. Rural Law. — Corresponds to Course 78. Spring term, yearly.
Credits, 5.
Mr. Smart.

186. Studies in Agricultural Legislation. Credits, 3–5.
The Department.

190–195. Investigation of Various Problems related to Agricultural Economics. — Credit given on basis of time spent and reports submitted.

200. Thesis. — Research work in agricultural economics will be developed by four principal methods, namely, historical, statistical, accounting and general field investigation. In all instances mastery of research methods includes facility in investigation, tabulation and interpretation of results.

Agricultural Education.

Major Requirements.

For the Degree of Master of Science.

Prerequisite Work. — A minimum of 25 undergraduate credits distributed among the following lines of study: philosophy, psychology, history of education, principles and methods of teaching, school organization and administration.

Required Work. — At least 50 credits must be earned from the following list of courses in the department or met by accepted transferred credits.

Graduate Courses Offered.

100. History of Education.	Credits, 1–10.
104. Vocational Education.	Credits, 1–10.
105. Curriculum Study.	Credits, 1–20.
110. Rural Education.	Credits, 1–15.
115. Vocational Teacher Training.	Credits, 1–10.
120. Theory and Use of Mental Tests.	Credits, 1–20.
125. Secondary Education.	Credits, 1–15.
130. Advanced Educational Psychology.	Credits, 1–20.
135. Educational Philosophy.	Credits, 1–20.
140. General Educational Research.	Credits, 1–20.
145. Teaching Method and Practice.	Credits, 1–10.
200. Thesis.	Credits, 15–35.

Minor Requirements.

Minor work is offered in the department for the degrees of doctor of philosophy and master of science. Candidates must have had the equivalent of 15 undergraduate credits in education.

Agronomy.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Candidates must have had undergraduate courses 25 and 27 as described in this catalogue, and should have had thorough training in the elements of the natural sciences.

Required Work. — Studies will be assigned from the courses listed below. Thesis problems may be chosen in the subject matter of soils, fertilizers or field crops.

For the Degree of Master of Science.

Prerequisite Work. — As above.

Required Work. — Assigned work will be selected from the courses listed below.

For the Degree of Master of Agriculture.

Prerequisite Work. — The same as for the degree of master of science in so far as it is essential to establish the professional approach to agronomy, but in addition the candidate must be familiar with agronomical practices.

Required Work. — As above.

Graduate Courses Offered.

110. Studies in the Culture of Field Crops.	Credits, 5–20.
115. The Fertilization of Field Crops.	Credits, 5–20.
120. Studies in Harvesting and Storage.	Credits, 5–20.
125. The Improvement of Field Crops.	Credits, 5–20.
130. Technology of Field Crops.	Credits, 5–20.
140. Soil Classification.	Credits, 5–20.
145. Studies in Soil Physics.	Credits, 5–20.
150. Moisture Relationships in Soils.	Credits, 5–20.
155. Studies in Soil Management.	Credits, 5–20.
160. Soil Technology.	Credits, 5–20.
170. Studies in Soil Fertility.	Credits, 5–20.
180. Fertilizer Technology.	Credits, 5–20.
190. Studies in Literature.	Credits, 5–20.
200. Thesis.	Credits, 15–50.

Minor Requirements.

Prerequisites are as stated for major work. In addition studies suited to the needs of the candidate will be selected from the above courses.

Animal Husbandry.

Major Requirements.

For the Degree of Master of Science or Master of Agriculture.

Prerequisite Work. — Candidate must have had the following courses, or their equivalents, before he can enter graduate work in this department: Animal Husbandry 25, 26, 50, 51, 52, 53, 75 and 78. He should also be able to show evidence of experience in practical animal husbandry.

Required Work. — At least 50 credits must be earned from the following list of courses offered by the department.

Graduate Courses Offered.

100. Advanced Breed History. Credits, 10.

110. Nutrition of Farm Animals. Credits, 10.

120. Reproduction of Farm Animals. Credits, 10.

200. Thesis. Credits, 25.

Minor Requirements.

Minor work in animal husbandry may include undergraduate Courses 50, 51, 53, 81 or 82, and such other work in reading and compilation of material as the instructor may outline. Written examinations will be conducted at the completion of each term's work.

Animal Pathology.

Minor Requirements.

Minor work in animal pathology for the degrees of doctor of philosophy and master of science consists of an especially planned course for graduate students. This is not an undergraduate course, but is arranged to meet the needs of graduate students who have not pursued a course in general pathology. It will continue throughout the year and include reviews in gross and microscopic anatomy, physiological, bacteriological, serological, biochemical and morbid anatomical phases of pathology. Written examinations will be given at the end of each term.

100. General Pathology. — As described above, fall term. Credits, 5.

120. General Pathology. — Continuation of 100, winter term. Credits, 5.

140. General Pathology. — Continuation of 120, spring term. Credits, 5.

160. Biochemical Phases of Pathology. — Second year, fall term. Credits, 5.

180. Pathological Histology. — Second year, winter term. Credits, 5.

Professor Gage.

Botany.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — The equivalent of certain undergraduate courses, determined by the department in the case of each student, is prerequisite.

Required Work. — Candidates will be required to take Courses 100 through 107, and 180, 190 and 200. Courses 150 through 155 may be taken for graduate credit in certain cases. The maximum number of major credits which may be earned in this way is thirty-two.

For the Degree of Master of Science.

Prerequisite Work. — The requirements are the same as for the degree of doctor of philosophy.

Required Work. — Candidates will take Courses 100 and 101 and all courses from 102 through 107 which are given during their term of residence, also 180, 190 and 200. In certain cases Courses 150 through 155 may be taken, but not more than 20 credits may be earned in this way.

Graduate Courses Offered.

Courses 100 through 106 are lecture courses. They are given in rotation, except Courses 100 and 101, which come every year.

100. Plant Physiology. — The lectures will consider, under the nutrition of the plant: its chemical structure, absorption of various nutrient substances and their changes in the plant, assimilation and dissimilation of carbon and nitrogen by autotrophic and heterotrophic plants; under changes in the form of plants: growth and form under constant external factors, the influence of variable external and inner factors on growth, form and development; and under plant movements: the various tropisms, nutations, etc. Supplemental demonstrations, laboratory work and readings in the standard texts and journals. One lecture a week for 36 weeks. Credits, 3.

101. Plant Pathology. — A general consideration of the history, nature and causes of plant disease; parasitism, predisposition, immunity, degeneration, natural and artificial infection, dissemination, epidemics, biologic strains, monstrosities and malformations, proliferation, prevention and control, economics of plant diseases. One lecture a week for 36 weeks. Credits, 3.

102. Plant Inheritance. — This course is planned to give the student a comprehensive understanding of the principles and facts of plant inheritance. A study is made of plant variations, Mendel's law of heredity, the physical basis of heredity as established by chromosome behavior, pure lines, mutations, species and graft hybrids, etc. One lecture a week for 12 weeks. Credit, 1.

103. Biologic Relations. — Consideration of certain phases of the morphological and physiological adaptations of plants with regard to insect visit; the rôle of thorns, hairs, tendrils, glands, etc. Various experiments are made to test out experimentally some of the existing theories concerning biologic adaptations. One lecture a week for 12 weeks. Credit, 1.

104. The Ecology of Plants. — This course deals with the water, light and temperature relations of plants, and the various adaptations in response to these factors; the various types of plant formation; the migration of plants; the competition of plants; invasion and successions of plants under varied conditions; and the various types of alternations and zonations. One lecture a week for 12 weeks. Credit, 1.

105. Physiological Plant Pathology. — This course considers those plant diseases not due to bacterial or fungous parasites, but resulting from unfavorable physical or chemical conditions of the soil; from harmful atmospheric influences, such as too dry air, too much moisture, hail, wind, lightning, frost; from injurious gases and liquids; from lack of or too much light; from wounds. A knowledge of the normal physiology of the plant is required. Demonstrations and laboratory work will be given, together with assigned readings. One lecture a week for 12 weeks. Credit, 1.

106. History of Botany. — An historical survey of the science; lives of noted botanists; history of certain culture plants, such as wheat, corn, coffee, potato, rice, and their influence on civilization; reading. One lecture a week for 24 weeks. Credits, 2.

107. Methods in Drawing and Photographing for Thesis and Publication. — Twelve weeks. Credits, 1–3.

108. The Comparative Anatomy of Green Plants. — See undergraduate Courses 61–63.

150. Systematic Mycology. — See undergraduate Courses 52–54.

151. Systematic Botany of the Higher Plants. — See undergraduate Courses 58 and 59.

152. Plant Histology. — See undergraduate Courses 55 and 56.

153. Cytology and Embryology. — See undergraduate Courses 82 and 83.

154. Plant Pathology. — See undergraduate Courses 75–77.

155. Plant Physiology. — See undergraduate Courses 78–80.

180. Seminar. — A weekly seminar for members of the department staff, graduate students and major senior students is held, at which important botanical papers are discussed. Attendance and participation are required. Credits, 3.

190. Collateral Reading. — Extensive reading of botanical literature in English, German and French, designed to give the student a broad knowledge of the science, is required of all major students. Final examinations are based in part upon this reading course. Credits, 5–10.

200. Thesis. — Each major student is required to select a problem in plant pathology or physiology (in other branches at the discretion of the department) for original investigation, and the thesis must embody a distinct contribution to knowledge. An effort will be made to assign problems having some bearing on scientific and economic agriculture. The thesis work counts for not more than 50 per cent of the total number of major credits required for either degree.

Minor Requirements.

For a minor a student may take such of the work offered by the department as seems best suited to his major course. Courses 150 and 155 are primarily undergraduate work which may be taken for minor credit toward advanced degrees. In most cases no problem will be assigned.

Professors Osmun, Anderson, Clark, Torrey and Davis.

Chemistry.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — The candidate must have taken undergraduate Courses 1 to 87, or their equivalent.

Required Work. — The candidate will be required to take all the graduate courses listed below. He may also be required to spend at least two terms or one semester at some other recognized institution, pursuing graduate study in chemistry. For the final examinations, questions will be selected from the entire field of chemistry, with special emphasis upon the lines of work covered by the research.

For the Degree of Master of Science.

Prerequisite Work. — The same as that required for the degree of doctor of philosophy.

Required Work. — The candidate will be required to take Courses 101 and 108 through 114. In addition he will pursue the requirements of one of the following thesis subjects: —

Organic and Biochemistry. — Course 200 and either 105, 106 or 107, and 3 credits for one term selected from Courses 103 (*b*) or (*f*), and 104.

Analytical and Industrial Agricultural Chemistry. — Courses 200, 103 (3 credits), and 3 credits for one term selected from Courses 102 and 104 through 107.

Physical Chemistry. — Courses 200, 104, and 3 credits for one term selected from Courses 102, 103 and 105 through 107.

Agricultural Chemistry. — Courses 200, 103 (3 credits), and 3 credits for one term selected from Courses 102 and 104 through 107.

The candidate must pass a final written and oral examination before the department upon undergraduate Courses 1 through 80, as well as upon all graduate work taken in chemistry.

Graduate Courses Offered.

101. Inorganic Preparations. — Laboratory. The preparation of chemical products from raw materials. The manufacture and testing of pure chemicals. The laboratory work is essentially synthetic in nature, and is designed to aid in acquiring a more adequate knowledge of inorganic chemistry than is to be obtained by chemical analysis alone. Ten to fifteen of the preparations given in Biltz's "Laboratory Methods of Inorganic Preparations" will be made by each student. Any term. Credits, 3.

Assistant Professor Serex.

102. Advanced Inorganic Preparations. — Laboratory. Continuation of Course 101. Any term. Credits, 3.

Assistant Professor Serex.

103. Advanced Analytical Chemistry. — Laboratory. This course may be taken in part as follows: (*a*) electrolytic analysis, 3 credits; (*b*) ultimate analysis, 3 credits; (*c*) special analytical work to meet the needs of the individual student, 3 credits. In addition, parts of undergraduate Courses 62, 76 and 77 may be taken, as follows: (*d*) fertilizers, 3 credits; (*e*) insecticides, 3 credits; (*f*) milk and butter, 3 credits. (*a*), (*b*), (*c*) may be taken any time; (*d*), (*e*), (*f*) must be taken at the time the undergraduate course is given.

Professor Peters.

104. Advanced Physical Chemistry. — Laboratory. Measurement of the electrical conductivity of solutions; degree of ionization; ionization constants; per cent hydrolysis of aniline hydrochloride from conductivity measurements; solubility product by the conductivity method; velocity of saponification by conductivity; neutralization point by conductivity; vapor pressure determinations; critical temperature of carbon dioxide or sulphur dioxide; transport numbers; preparation and properties of colloidal solutions; transition points by dilatometric method; heat of solution of ammonium chloride and potassium nitrate; adsorption of iodine by charcoal; splitting of racemic glyceric or racemic tartaric acid into its optical components. To each student separate work will be assigned. Any term. Credits, 3.

Assistant Professor Serex.

105. Advanced Organic Preparations. — Laboratory. The preparation of compounds not included in Courses 51 and 52, such as the Kolbe synthesis of salicylic acid; benzophenone and Beckmann's rearrangement; rosaniline, malachite green, Congo red, indigo and other dyes; synthesis of fructose; Grignard reaction. Barnett, Cain & Thorpe, Gattermann, Noyes, Fischer and other laboratory guides are used. To each student separate work will be assigned. Any term. Credits, 3.

Professor Chamberlain.

106. Advanced Biochemistry. — Laboratory. The hydrolysis of proteins and isolation of the amino acids; the study of milk, blood and urine; dietary and digestion studies. References: Abderhalden, Plimmer, Salkowski, Hawk, etc. To each student separate work will be assigned. Any term. Credits, 3.

Professor Chamberlain.

107. Industrial Organic Chemistry. — Laboratory. The preparation, on a large scale, of wood alcohol, acetic acid, ethyl alcohol, benzene and cellulose products, such as mercerized cotton and artificial silk. References: Molinari, Rodgers & Aubert, Thorpe, Enzyklopädie der tech. Chemie, etc. To each student separate work will be assigned. Any term. Credits, 3.
Professor Chamberlain.

108. Theoretical Chemistry. — Lectures. The following topics are considered: the compressibility of the atoms; the structure of atoms; the electron conception of valence. First term. Alternates with Course 109. Credit, 1.
Professor Peters.

109. Analytical Chemistry. — Lectures. A general survey of methods and technique covering processes commonly carried out in the laboratory. Gooch's "Quantitative Analysis" is used as a text. First term. Alternates with Course 108. Credit, 1.
Professor Peters.

110. Organic Chemistry. — Lectures. Some of the following topics will be considered both theoretically and industrially: alkaloids, synthetic dyes, essential oils, terpenes, rubber, etc.; the study of methods for carrying out general reactions; isomerism, tautomerism, condensation, etc. References: Cain & Thorpe, Cohen, chemical monographs, Lassar-Cohn, Heinrichs, Molinari. Second term. Alternates with Course 111. Credit, 1.
Professor Chamberlain.

111. Biochemistry. — Lectures. Some of the following topics will be considered both chemically and physiologically: fats, cholesterol, lecithin, carbohydrates, amino acids, proteins, urea, uric acid, purine bases, enzymes, fermentation, animal food and nutrition, photosynthesis. References: Monographs on biochemistry, Abderhalden, Plimmer, Haas & Hill, Lewkowitsch, Fischer, Euler, Mathews, Czapek. Second term. Alternates with Course 110. Credit, 1.
Professor Chamberlain.

112. Theoretical and Physical Chemistry. — Lectures. The relation between the constitution and properties of compounds; mutarotation; steric hindrances; stereoisomerism of other elements than carbon; molecular association; similarity between the compounds of silicon and carbon. Third term. Alternates with Course 113. Credit, 1.
Assistant Professor Serex.

113. Theoretical and Physical Chemistry. — Lectures. Radioactivity; the application of physical chemistry to industrial chemistry. Third term. Alternates with Course 112. Credit, 1.
Assistant Professor Serex.

114. Seminar. — Conferences, reports or lectures. Three terms, twice a month. Credit, ½.
Professor Lindsey.

200. Thesis. — Research, and, in the case of a degree, the preparation of an acceptable thesis in agricultural, analytical, organic or physical chemistry, under the direction of the professor in charge of the work, provided that a candidate for the degree of doctor of philosophy shall have had the equivalent of Courses 51, 52, 65 and 86. Credit determined by work done.

Minor Requirements.

Work may be selected from any of the undergraduate Courses 27 and 51 to 80, or any of the graduate courses for which the student is prepared. In addition, the candidate may be required to pass a final written and oral examination before the department upon his entire minor work.

Entomology.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Students must have had all the undergraduate courses given at this college or their equivalent. Opportunities to make up any deficiencies will be available while the graduate work is being carried on.

Required Work. — The graduate courses consist of lectures on all, and laboratory work on a part, of the subjects given below, together with advanced readings, seminar work and original research.

For the Degree of Master of Science.

Prerequisite Work. — The same as for the degree of doctor of philosophy.

Required Work. — A major course for the master of science degree will be about half of the courses listed below.

Graduate Courses Offered.

100. Morphology. — 1. Embryonic development of insects and polyembryony.
2. Metamorphosis and its interpretations.
3. Advanced external and internal anatomy.
4. Insect histology and physiology.
5. Ancestry and development of insects, including fossil insects.
6. Hermaphrodites in insects.
7. Hybrids.
8. Parthenogenesis, pedogenesis and heterogeny.
9. Chemistry and physics of insect colors.
10. Color patterns, their significance and value.
11. Luminosity.
12. Deformities.
13. Variation in insects.

120. Ecology. — 1. Dimorphism and polymorphism.
2. Mimicry, including concealment, protective devices and warning coloration.
3. Architecture of insect structures.
4. Relation of insects to plant fertilization and its importance.
5. Insect products of value to man.
6. Geographical distribution and methods of distribution of insects, with a consideration of life zones, barriers, etc.
7. Insect migrations.
8. Insect behavior and experimental entomology.
9. Enemies of insects.

140. Economic Entomology. — 1. Control methods.
2. Insect photography and methods of preparing illustrations.
3. Field work and life history investigations with methods for keeping records.
4. Legislation about insects.
5. Studies of insecticides and their application.

160. Systematic Entomology. — 1. History of entomology and of classifications.
2. Lives and works of prominent entomologists.
3. Abundance of insects.
4. Important collections, public and private; their location and their value.
5. Types of insects; their significance, importance and location.
6. Rules of nomenclature and how they are used.
7. Methods for collecting, preparing, preserving and shipping insects.

180. SEMINAR. — Readings and reports on the current literature of entomology; monthly meetings.

190. COLLATERAL READINGS. — The best articles on the various topics in entomology are assigned for collateral readings, and are included in the final examinations.

200. THESIS. — Original research on one or several topics in morphology, ecology, economic and systematic entomology. This is expected to require from one-half to three-quarters of the total working time of the student.

MINOR REQUIREMENTS.

Minor courses will cover such parts of the work outlined above as will be most likely to prove useful in connection with the majors taken by the students, or in their future work. It is not required that such men shall have had all the undergraduate work in entomology given at this college, their credit for a minor beginning where their own undergraduate training in the subject ended.

Horticulture.

Graduate work is offered in various lines of horticulture. For the most part this is divided into the different departments which constitute the college Division of Horticulture, as follows: pomology, floriculture, landscape gardening, forestry and market gardening. For work in these lines application should be made direct to the heads of the several departments.

Besides this work, however, opportunity is offered for graduate study in general horticulture, including topics from the several organized departments mentioned, and also questions relating to plant breeding, general evolution, propagation, manufacture of horticultural products, etc. This general work is under the direction of Professor Waugh, head of the Division of Horticulture.

Landscape Architecture.

MAJOR REQUIREMENTS.

For the Degree of Master of Landscape Architecture.

PREREQUISITE WORK. — The undergraduate courses in the college known as Landscape Gardening 50, 51 and 52, Drawing 25, 26 and 27, Horticulture 50 and 51, and Mathematics 26 and 27 will be considered prerequisite to graduate work, and any student who has not passed these courses, or their equivalent, will be required to make up such work without graduate credit.

REQUIRED WORK. — Each student before he may receive the master's degree with a major in this department must convince his instructors that he has a genuine aptitude for some branch of landscape gardening, either in design, construction or management.

The minimum period of graduate study will be one and one-half years. At least one year of this time must be spent in residence at the college. One year must also be spent in practice outside the college. The work done outside the college may be prescribed by the department, and must be fully reported to the department in writing. It is essential, further, that the candidate secure the written approval of his employers outside the college. The department may, at its discretion, require a longer period of study at the college or a longer apprenticeship outside the college.

Every student before receiving his master's degree in landscape architecture must have given some thorough and fruitful study to each of the following five departments. As far as possible these studies must be of a practical nature, *i.e.*, they must be made upon actual projects in progress of development.

1. *Theory.* — The principles of esthetics as applied to landscape architecture.

2. *Design.* — The principles of pure design and their application in landscape and garden planning.

3. *Construction.* — The practical methods of carrying out landscape plans, laying out, equipment, organization of working force, time and cost keeping, etc.

4. *Maintenance.* — Methods, organization, cost.

5. *Practice.* — Office work, drafting, estimating, reporting, charges, accounting.

While great freedom is allowed to graduate students in their plans of work, a certain portion of time will always be given to systematic courses of instruction. Courses known as Landscape Gardening 175, 176, 177, 178, 179, 180, 181 and 182 are required, and may or may not be accepted for graduate credit, at the discretion of the department.

GRADUATE COURSES OFFERED.

175. THEORY OF LANDSCAPE ART. — Same as Landscape Gardening 75. First term. Credits, 3.
Professor WAUGH.

176. CIVIC ART. — Same as Landscape Gardening 76. Second term.
Credits, 4.
Professor WAUGH.

177. COUNTRY PLANNING. — Same as Landscape Gardening 77. Third term.
Credits, 4.
Professor WAUGH.

178. ARCHITECTURE. — Same as Landscape Gardening 78. Third term. Given in alternate years. Credits, 3.
Assistant Professor HARRISON.

179. CONSTRUCTION. — Same as Landscape Gardening 79. Third term. Given in alternate years. Credits, 3.
Assistant Professor HARRISON.

180. THEORY OF DESIGN. — Same as Landscape Gardening 80. First term.
Credits, 4.
Professor WAUGH.

181. ESTATE DESIGN. — Same as Landscape Gardening 81. Second term.
Credits, 4.
Assistant Professor HARRISON.

182. PARK DESIGN. — Same as Landscape Gardening 82. Third term.
Credits, 4.
Assistant Professor HARRISON.

190. THEORY. — Special studies. Credits, 2–10.
The DEPARTMENT.

191. DESIGN. — Individual problems by arrangement. Credits, 2–10.
The DEPARTMENT.

192. CONSTRUCTION. — Individual problems by arrangement. Credits, 2–10.
The DEPARTMENT.

193. MAINTENANCE. — Special studies, experimental work or assigned problems.
Credits, 2–10.
The DEPARTMENT.

194. Practice. — Professional field work under supervision. By arrangement.
Credits, 2–10.
The Department.

195. Seminar. Credits, 1–5.
Professor Waugh.

200. Thesis. — Each student before receiving the master's degree with a major in landscape architecture must present a satisfactory thesis or complete project. A thesis will consist of a careful original study of some problem in landscape architecture, presented in typewritten form with any necessary illustrations, such as photographs, diagrams, drawings, etc. A project will consist of a completed set of studies of some suitable landscape-gardening problem, such as the design of a park, a real estate subdivision, an extensive playground. Such a project will usually consist of —

(*a*) Original surveys, including topography.
(*b*) Block plans, showing original design.
(*c*) A rendered plan or plans of the main features.
(*d*) Detailed working drawings.
(*e*) Estimates of cost.
(*f*) Complete report and letter of transmittal.

Credits, 5–20.

Minor Requirements.

Any student electing a minor in landscape architecture will be directed to take such courses from the regular catalogue list as may seem most suitable to him. Under ordinary circumstances no other work will be given to students electing minors. In special cases, however, individual problems will be assigned and individual instruction given. These exceptions will be made in cases where, by so doing, it is possible to give the student material assistance in the plan of his major work.

Microbiology.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Candidate must have had Courses 50, 51, 52, 80, 81, 82 and 83, or their equivalents, before he can enter upon graduate work.

Required Work. — Studies will be selected from the courses offered below. It will be the purpose of the department to distribute such studies among the courses offered in a manner to gain the greatest efficiency and a comprehensive knowledge of the entire field. The work will be conducted by prescribed readings, critical written reviews, conferences, lectures and laboratory exercises.

For the Degree of Master of Science.

Prerequisite Work. — The same as for the degree of doctor of philosophy.

Required Work. — Courses of a basic and applied character selected from the courses offered below which will prepare the student for effective effort.

Graduate Courses Offered.

100. History of Microbiology. Credits, 5–10.

110. Cytological and Morphological Studies and Corresponding Technique. Credits, 5–10.

120. Studies in Technique and Methods. Credits, 5–20.

130. Physiological Studies. Credits, 5–20.

135. Industrial Fermentations. Credits, 5–10.

140. Agricultural Microbiology — General Survey. Credits, 5–20.

141. Microbial Studies in Agriculture. Credits, 5–10.

150. Soil Microbiology. Credits, 5–20.

160. Dairy Microbiology. Credits, 5–20.

170. Food Microbiology. Credits, 5–20.

180. Hygienic Microbiology. Credits, 5–20.

181. Special Sanitary or Hygienic Studies. Credits, 5–10.

190. Lectures and Study of Literature. Credit, 1 each term.

200. Thesis. — Some microbiological problem related to agriculture or food. Distributed as may be most beneficial for research work. Time and credit by arrangement. Credits, 15–50.

Minor Requirements.

Minor work in microbiology may consist of undergraduate Courses 50, 51, 52, and other courses designed to support the major work, from among the courses offered above. The candidate will also be required to pursue graduate Course 190, or follow a course of reading and conferences through three terms. In case the candidate has had some of these courses, he will be required to take more advanced substitute courses.

Pomology.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Candidates must have had the equivalent of the courses required for graduation from this college; also sufficient practical experience to enable them to understand and appreciate the problems of orchard practice.

Required Work. — The work outlined below will be required of all candidates.

For the Degree of Master of Science.

Prerequisite Work. — The same as for the degree of doctor of philosophy.

Required Work. — One-half of the work outlined below, selected to meet the needs of the individual student, will be required.

Graduate Courses Offered.

101. Experimental Methods. Credits, 15–20.

A critical study of the methods of research that have been used or may be helpful in pomological work. The following topics will be considered from the point of view of the investigator in pomology.

1. Statistical methods.
2. Measures of growth and yield.
3. The conduct of plot experiments.
4. Methods of soil study in their relation to pomological research.
5. Chemical methods of pomological research.
6. Methods of physiology applicable to fruit plants.
7. Microchemistry.

102. Pomological Research. Credits, 15–20.

A critical survey of past and current research work in pomology. Semi-weekly meetings for reports and discussions will be held. The following topics will be taken up.

1. Orchard soil management.
2. Soil fertility and fertilizers.
3. Physiology of pruning tree fruits and bush and vine fruits.
4. Fruit bud differentiation.
5. Sterility and fertility.
6. Genetics of fruit plants.
7. Climatology and winter injury.
8. Advanced morphology.
9. Spraying machinery and equipment.
10. Special practices.

103. Advanced Laboratory Work. Credits, 5–12.

Each student will be required to become familiar with the research work of the department and to have a share in it. So far as this has value as graduate work he will receive credit.

104. History of Pomology. Credits, 2–5.
The men, institutions and other influences that have contributed to the development of the science and art of pomology.

105. Horticultural Taxonomy. Credits, 2–3.
A study of the history and development of plant classification with special reference to horticultural plants. A study of modern classification carries with it an expression of opinion as to the evolution of cultivated plants.

106. Advanced Systematic Pomology. Credits, 6–10.
The principles of systematic pomology including a study of nut and subtropical fruits not usually dealt with in undergraduate courses.

200. Thesis. Credits, 40–50.
Each student will be required to carry out an original investigation of an assigned problem. In the planning, executing and interpreting the data of this problem he must show marked ability. The results are embodied in a thesis to be passed upon by the Department and the Graduate Staff.

Minor Requirements.

Students taking a minor in pomology will select such of the above courses as may be suited to their needs. Certain advanced undergraduate courses may also be taken for minor credit.

Poultry Science.

Major Requirements.

For the Degree of Master of Science or Master of Agriculture.

Prerequisite Work. — The postgraduate course presupposes all undergraduate work or its equivalent, together with practical experience. Without the latter, students will be unable to handle Courses 140, 150 and 160. At the discretion of the instructor in charge, graduate students may be required to pursue undergraduate courses in other departments without credit.

Required Work. — All the courses listed below. Practical poultry work may be required, but no credit will be given for such work.

Graduate Courses Offered.

101. Reading. — A review of the entire field of poultry literature, covering books, bulletins and special articles, is made, and a written report on one or more subjects required.

110. Seminar. — A critical review and a criticism of the more important experiments carried on at various stations in this and other countries; also a study of poultry conditions in foreign countries, methods of management, etc., besides a detailed study of some of the largest poultry projects in this country.

120. Anatomy (Gross and Histological), Physiology and Surgery. — This course requires a careful study of the anatomy and physiology of the fowl. Special attention is given to a study of those structures concerned with practical poultry problems. Instruction in surgical technique, adapted to fowls, may also be given.

130. Breeding. — The student will carry on such breeding experiments as time and facilities permit. He may also do work in connection with our regular experimental projects. A detailed study of the pertinent literature will be required. Animal Husbandry 5, or its equivalent, is a prerequisite.

140. Feeding. — A study of the relation of various foods and other substances to the morphology and physiology of the bird, with special reference to such subjects as egg production, feather form and structure, condition of flesh, bone, etc.

150. Brooding. — Studies will be made upon the relation between viability and rate of growth and the following topics: type of brooder, number of chicks in brood, ventilation, humidity, sanitation, exercise and weather conditions; also a comparison of natural methods with artificial methods of rearing chicks.

160. Incubation and Embryology. — A number of problems of a practical, scientific and mechanical nature relating to incubation are considered. The work in embryology is of an advanced nature, dealing with its relation to morphogenesis and heredity, and presupposes an elementary knowledge of the embryology of the chick.

170. Poultry Diseases and Sanitation. — In this course a study is made of various problems in poultry sanitation, with particular reference to methods relating to the control and eradication of disease.

200. Thesis.

Minor Requirements.

Courses 101 and 110 are designed particularly for minors.

Rural Sociology.

Major Requirements.

For the Degree of Doctor of Philosophy.

Prerequisite Work. — Candidates must present satisfactory evidence of having completed at least 10 credit hours in general sociology and 10 credit hours in general economics; or take such undergraduate courses as the department may designate to satisfy this requirement.

Required Work. — Candidates must take or pass by satisfactory examination courses offered by the department for undergraduates bearing the numbers 26, 50, 51, 52 and 75, and such courses in agricultural education and agricultural economics as may be required, not to exceed 10 credit hours in each department.

Candidates will be required to select from the courses listed below as graduate courses a field for investigation and intensive study. Candidates for the doctorate must take all courses listed as graduate.

For the Degree of Master of Science.

Prerequisite Work. — The same as for the degree of doctor of philosophy.

Required Work. — Not less than 50 credit hours will be required from the courses listed below. The department will make such selection as may best meet the interest of the individual student.

Graduate Courses Offered.

177. Field Work of an Investigational Nature.

178. Rural Social Surveys.

179–181. Seminar.

182. Social Conditions of American Rural Life.

183. Social Conditions of European Rural Life.

184. Rural Institutions.

185. Rural Organization.

186. Farmers' Organizations.

187. Town and Village Rural Life.

188. Rural Health and Sanitation.

189. Rural Literature.

190. Rural Government and Law.

200. Thesis.

Veterinary Science.

Work is available in hygiene, veterinary pathology, and other special lines or divisions of the subject.

Zoölogy.

Minor Requirements.

Courses in zoölogy may be available as a minor for the degrees of doctor of philosophy and master of science. The nature of the work will necessarily vary according to circumstances, and may be intensive in a special field and correlated closely with the major work of the student, or it may be of a more general character, depending on the student's needs or previous acquaintance with general zoölogical science.

The Short Courses.

The short courses offered by the Massachusetts Agricultural College are designed to meet the needs of those, both young and old, who cannot come to the college for the regular college courses. They furnish the student with instruction in modern accepted methods, and are planned to help the farmer and the housewife.

The short courses include: —

A. The Two-year Course in Practical Agriculture.
B. The Ten Weeks' Winter School.
C. The Summer School.
D. The Vocational Poultry Course.

Requirements for Admission to Short Courses. — Students must be at least seventeen years of age, and must furnish satisfactory evidence of good moral character. References are required. There are no entrance examinations. The sole test is ability to do the prescribed work. Students enrolling for the Two-year Course in Practical Agriculture must have at least a common school education.

Expenses of Short Courses. — The expense of attending any of the short courses is approximately as follows: —

Furnished rooms in private houses (per week)	$3 to $5
Board at college dining hall (per week)	$7
Board with private families (per week)	$6.50 to $9
Registration fee (Ten Weeks' Winter School)	$5

Tuition in all the short courses is free to residents of the Commonwealth. Small laboratory fees are charged in some of the courses.

A. Two-year Course in Practical Agriculture.

The Two-year Course in Practical Agriculture is offered to meet the needs of students who for one reason or another cannot take the four-year college course. It is designed to provide a large amount of practical information and training in agriculture and horticulture.

It will appeal, not only to young men and women, but also to men and women of mature years and practical experience who wish to know more about the business of farming. Although the course is planned to meet the needs of those who are not graduates of high schools, the instruction is not preparatory or elementary in its nature, but is so planned that it will be of value to all. The greater amount of academic training that some of the students may possess will in a measure be offset by the fund of practical knowledge possessed by many who have completed only the elementary schools.

The course is not intended for students enrolled in high schools. Such students should finish the high school course. Students enrolled in high schools who wish to take the course should bring a statement either from the principal of the high school or from parent or guardian asking permission to be enrolled.

The Two-year Course in Practical Agriculture is arranged so as to provide specific vocational training for the particular lines of agricultural work which the students may select. When a student enrolls he is required to state the type of

farming in which he expects to engage; and to select from the following courses of study the one he wishes to pursue: —

1. General agriculture, with animal husbandry as the principal subject.
2. General agriculture, with poultry as the principal subject.
3. Dairy manufactures.
4. General horticulture.
5. Pomology.
6. Floriculture.
7. Vegetable gardening.

He then pursues a specially arranged course of preparation for that type of work. This specialization does not prevent his securing a general working knowledge of other subjects in which he may be interested.

The advantages of the college staff of specialists and the college plant with all its resources are thus made available to young men and young women who may not have had the opportunity of securing a high school education.

The first year consists of six months of study at the college. The term begins with the college fall term and closes with the winter term of the regular session. The same vacation periods are observed as in the regular four-year course.

At the close of six months of study, students are required to gain six months of farm experience. The college will assist students in finding positions and in placing them on farms where the experience gained will be of great advantage. Thus an effort will be made to place on a dairy farm the man expecting to take up dairying as his chief line of work, and a student of pomology on a fruit farm.

During the second year the student spends nine months in resident study, completing the subject pursued in the first year.

Each student is required to file with the treasurer of the college a statement, signed by the town (or city) clerk of the town (or city) from which he enrolls, stating that the parent or guardian of the student is a resident of that town.

Certificate. — Students completing satisfactorily work prescribed in the Two-year Course will receive certificates.

Credits earned in the Two-year Course in Practical Agriculture or in any other of the short courses except the Summer School, do not lead to the college degree.

Tuition. — Tuition is free to residents of Massachusetts. Students who are not residents of Massachusetts are charged a tuition fee of $60 a term.

B. THE WINTER SCHOOL.

The Winter School, beginning usually about January 1 and continuing for ten weeks, was started several years ago, and has always been very popular, not only with more mature farmers and their wives, but with young men and women who control or manage farms. The courses, though short, are very practical in their nature, and are so arranged that a student may choose such subjects as will enable him to specialize along the line of work in which he is most interested. There is a wide range in the choice of subjects, making it possible for the student to take work for several winters in succession. Many college graduates enroll for the Winter School.

Scholarships. — The Jewish Agricultural and Industrial Aid Society of New York has instituted a system of free scholarships to enable the children of Jewish farmers to attend the short winter course in the States in which they reside. The stipend is sufficient to pay all the expenses of the holder for the course. Such expenses usually amount to from $100 to $150. The following courses are offered: —

Outline of the Ten Weeks' Winter School, January 2 to March 10.

Soil Fertility. Three lectures a week.
Field Crops. Two lectures and one two-hour laboratory period per week.
Types and Breeds of Livestock. Three lectures and two two-hour laboratory periods a week.

Livestock Feeding. Three lectures per week.
Animal Breeding. One lecture and one two-hour laboratory period per week.
Dairying. Five lectures and five laboratory periods per week.
Dairy Bacteriology. Two lectures and one two-hour laboratory period per week.
Animal Diseases and Stable Sanitation. Two lectures per week.
Poultry Husbandry. Five lectures and one two-hour laboratory period per week.
Fruit Growing. Three lectures and one two-hour laboratory period per week.
Market Gardening. Three lectures and two two-hour laboratory periods per week.
Floriculture. Five lectures per week.
Horticultural Manufactures. Two lectures and two laboratory periods per week.
Farm Management. Two lectures a week.
Farm Accounts. Two two-hour laboratory periods per week.
Marketing. Two lectures a week.
Agricultural Credit. Two lectures a week.
Botany. Two lectures a week.
Entomology. Three lectures per week.
Farm Structures. Two lectures and one two-hour laboratory period per week.
Farm Machinery. Two lectures and three two-hour laboratory periods a week.
Rural Sanitary Science and Hygiene. Two lectures per week.
Vocational Guidance. One lecture per week.
Foods. One lecture and two two-hour laboratory periods per week.
The Business of the Household. Three class hours per week.
Home Care of the Sick. Three class hours per week.
Principles and Methods of Vocational Agricultural Teaching. Five exercises per week.
Special Methods in Vocational Agricultural Teaching. Five exercises per week.
Professional Improvement Problems. Five periods per week.

C. THE SUMMER SCHOOL.

The Summer School has been maintained by the college for a number of years. The experience of these years has been a value in arranging short, intensive, practical courses that will meet the needs of teachers, home makers and professional workers who wish instruction in agriculture, agricultural education and home economics, and who can most conveniently come to the college during the summer. The instruction is given by the regular members of the college staff, assisted by outside lecturers. The term period is six weeks.

College credit is now offered for work in the Summer School. For teachers and other students interested in professional improvement, or working for degrees, this change is especially valuable.

While agricultural courses were not presented during the past summer, if a demand develops for such work, it will be included in the program.

The nature of the work of the Summer School is indicated by the following typical program: —

Agriculture and horticulture: —
- Poultry husbandry
- Fruit growing
- Flower growing
- Vegetable gardening
- Food preservation
- Beekeeping

Home economics: —
- Foods and nutrition
- Preparation and serving of meals
- Garment making
- Dress design and construction
- Millinery
- House furnishing
- Home management

Related subjects: —
- Insect life
- Bird life

Related subjects — *Concluded.*
- Recreation
- Dramatic presentation
- Design and practical arts
- Rural sociology
- Hygiene and sanitation
- General science
- Public health

Agricultural education: —
- Principles and methods of teaching
- Special methods in vocational agricultural teaching
- Professional improvement problems
- Supervision and administration of agricultural education
- Vocational education
- Educational psychology
- Mental tests

Special courses for students deficient in college entrance are offered in the following subjects: —

Preparatory algebra.
College entrance English.
Plane geometry.

D. ONE-YEAR VOCATIONAL COURSE IN POULTRY HUSBANDRY.

Purpose. — This course is designed for graduates of the agricultural vocational schools and others who wish to prepare themselves for practical poultry keeping, and can spend only one year at college.

Scope. — The work covers seven detailed courses in poultry husbandry, as well as short-course work in fruit growing, market gardening, animal husbandry, or other subjects that will be helpful to poultry raisers. In addition to classroom and laboratory exercises each student is required to put in from eight to ten hours per week at the plant in the care and management of poultry, for the purpose of becoming proficient in the various branches of the work.

Entrance Requirements. — Applicants must be at least eighteen years of age and have a good elementary education.

Fees. — There is no tuition for residents of Massachusetts, but a laboratory fee of $5 is required for both the fall and spring terms.

Note. — The course is limited to sixteen students. The One-year Poultry Course begins at the beginning of the winter term and continues until the following December.

General Information.

A. FINANCIAL AND ADMINISTRATIVE.

Student Expenses.

Tuition.[1] — Tuition is free to residents of Massachusetts. Students who are not residents of Massachusetts are charged a tuition fee of $180 a year. Students entering from Massachusetts are required to file with the president a statement signed by either town or city clerk stating that the applicant's father is a legal resident of Massachusetts.

All students entering the college for the first time as undergraduates or two-year students are charged a matriculation fee of $5, which in event of a student leaving the institution shall, if all bills due the college are paid, be remitted, or which shall upon graduation be considered as payment for the diploma.

Dormitories and Board. — The college has dormitory accommodations for about 62 men students. The rooms in the dormitories are occupied by the upper classmen, hence new students find it necessary to room in private houses. The rooms in the college dormitories are unfurnished; for the most part they are arranged in suites of three, — one study room and two bedrooms. These rooms are heated by steam and lighted by electricity; they are cared for by students occupying them. The dormitory rent for each person varies from $39 to $66 a year. The rent for furnished rooms in private houses ranges from $1 to $4 a week for each occupant. Correspondence in regard to rooms should be addressed to the dean of the college.

Board may be obtained at the college dining hall. At present, the price of board there is $7 a week.

Expenses.

The necessary college expenses are estimated as follows: —

Tuition: citizens of Massachusetts, free; others, $180 per year.

	Low.	High.
Matriculation fee, first year	$5 00	$5 00
Room in college dormitories or in private houses	39 00	110 00
Board, $7 per week	45 00	45 00
Laundry, 50 to 85 cents a week	18 00	30 00
Laboratory fees	5 00	25 00
Books, stationery and miscellaneous items	38 00	60 00
	$350 00	$475 00

Other Expenses. — Prospective students should understand that the above estimates cover expenses which may be called strictly college expenses, and that there are other financial obligations voluntarily placed upon students which they should expect to meet. Chief among these are class assessments and taxes levied for maintenance of various organizations, such as the Social Union, Athletic Association, weekly publications, etc. Such expenses vary from $15 to $30 a year. Additional financial responsibility is also assumed by students joining a fraternity or entering into other social activities of the college. Students rooming in college dormitories are obliged to equip their own rooms with furniture. The college assumes no responsibility in regard to the safe keeping of student property either

[1] This statement applies to those registering as regular or two-year students.

during the college term or vacations, except under such special arrangement as may be made with the treasurer. Besides the amount necessary for clothes and traveling, the economical student will probably spend between $400 and $500 per year.

Initial Charges.

At the opening of the college year, before students are registered in their classes, the following charges are payable at the treasurer's office:

	Freshmen.	Sophomores.	Juniors and Seniors.
Matriculation fee	$5 00	–	–
Board (if at college dining hall) four weeks in advance	28 00	$28 00	$28 00
Assessment for support of Social Union	1 50	1 50	1 50
Laboratory fees	5 00	5 00	2 00–10 00
Room rent (if in college dormitory)	–	–	12 00–20 00
Student tax for support of athletics[1]	5 00	5 00	5 00
Student tax for support of nonathletic activities[1]	3 00	3 00	3 00

[1] While this is not essentially a college charge, the treasurer of the college acts as collector for the student activity, and all students are expected to make the payment as indicated. The subscription price of the "Collegian" is fixed by the managers; the amount of athletic tax by vote of the student body.

Laboratory Fees.

The principles observed in establishing laboratory fees are the requirement that students pay for those materials actually used which cannot be supplied by the individual, and that the laboratory fees include a charge sufficient to guard against wanton waste and breakage. Fees may be established for any course without previous announcement. At present, the fees charged are as follows:

	Per Term.
Agronomy:	
Course 27	$2 00
Course 50	2 50
Course 51	2 50
Course 75	2 00
Course 77	2 50
Course 78	2 50
Animal husbandry:	
Course 25	1 50
Course 26	1 50
Course 75	1 50
Dairying:	
Course 50	3 00
Course 51	3 00
Course 75	3 00
Course 76	3 00
Course 77	3 00
Farm management:	
Course 75	1 50
Poultry husbandry:	
Course 51	2 50
Course 52	3 00
Course 76	2 00
Course 77	2 00

	Per Term.
Rural engineering:	
Course 75	$1 50
Course 78	1 50
Floriculture:	
Course 50	2 50
Course 51	2 50
Course 52	2 50
Course 53	2 50
Course 55	2 50
Course 75	2 00
Course 76	2 00
Course 77	2 50
Forestry:	
Course 56	2 00
Course 57	3 00
Course 58	4 00
Landscape gardening:	
Course 50	2 50
Course 51	2 50
Course 52	2 50
Course 76	3 00
Course 77	3 00
Course 80	3 00
Course 81	3 00
Course 82	3 00

	Per Term.
Pomology:	
Course 54	$4 00
Course 75	4 00
Vegetable gardening:	
Course 50	2 00
Course 52	2 00
Course 53	2 00
Course 75	3 00
Course 76	2 00
Drawing:	
Course 25	3 00
Course 26	3 00
Course 27	3 00
Botany:	
Course 3	1 50
Course 25	1 50
Course 26	1 50
Course 50	2 00
Course 51	2 00
Course 52	2 00
Course 53	2 00
Course 54	2 00
Course 55	3 00
Course 75	3 00
Course 76	3 00
Course 77	3 00
Course 78	3 00
Course 79	3 00
Course 80	3 00
Chemistry:[1]	
Course 1	3 00
Course 2	3 00
Course 4	3 00
Course 5	3 00
Course 25	4 00
Course 26	4 00
Course 30	3 00
Course 51	5 00
Course 52	5 00
Course 62	5 00
Course 80	4 00
Course 86	5 00
Course 91	5 00
Course 92	5 00
Course 93	5 00
Course 94	5 00
Course 95	5 00
Entomology:	
Course 50	1 00
Course 51	1 00

	Per Term.
Entomology — *Concluded.*	
Course 53	$1 00
Course 54	1 00
Course 55	1 00
Course 75	2 00
Course 76	3 00
Course 77	3 00
Course 78	3 00
Mathematics and engineering:	
Course 27	1 50
Course 78	1 50
Microbiology:	
Course 50	5 00
Course 51	5 00
Course 52	5 00
Course 75	5 00
Course 76	5 00
Course 80	5 00
Course 81	5 00
Course 82	5 00
Course 83	5 00
Physics:	
Course 27	3 00
Course 50	3 00
Course 51	3 00
Course 52	3 00
Veterinary science:	
Course 78	2 00
Course 79	2 00
Course 80	2 00
Course 85	2 00
Course 86	2 00
Course 87	2 00
Zoölogy:	
Course 26	3 00
Course 50	3 00
Course 51	3 00
Course 52	3 00
Course 75	3 00
Course 76	3 00
Course 77	3 00
Course 79	2 00
Music (each course)	3 00
Rural home life:	
Courses 25, 27	1 50
Courses 50, 51, 52	4 00

[1] An additional deposit of $1 for Courses 1 to 6, inclusive, and $2 for Courses 25 to 95, will be required to cover individual breakage. In case the laboratory breakage does not equal the deposit, the balance will be refunded.

Rooms.

Students are expected, as far as possible, to occupy rooms in the college dormitories. Students who do not live in the college dormitories must secure rooms approved by the college. The assignment of rooms, and the general supervision of the housing of students, is in charge of the dean. At the end of each college year all unoccupied rooms will be thrown open for selection, and will be assigned to students according to classes.

Living Accommodations for Women Students.

Women students attending the college live in a dormitory provided for them, and take their meals at Draper Hall, which is located a short distance from the women's dormitory. The women's dormitory accommodates 98 girls, and is furnished. The present charge for room and board for women students is $120 per term.

Student Aid.

Self-help. — Many students are obliged to find work of some sort to earn their way through college. A few men have met their entire expenses in this manner, many more have paid a large part of their expenses, and many have earned a small proportion of the cost of their college education; but the college recommends that no new student enter without having at least $200 and preferably $300 with which to pay his way until he can establish himself in some regular work. The college does not encourage students to enter without money in the expectation of earning their way entirely. The ordinary student will find it better either to work and accumulate money before coming to college, or to take more than four years in completing his college course, or, instead, to borrow money sufficient to carry him through. No student should undertake work that interferes with his studies, and students should understand that, owing to the large number of applications for employment, no one man can receive a large amount of work at the college. A number of students find opportunities for earning money without depending upon the college to furnish them with work.

So far as possible needy students will be employed in some department of the college. The divisions of agriculture and horticulture usually afford the most work, although there are several permanent janitorships available for students, and forty or more students are employed at the dining hall.

Application for student labor should be made directly to Edward M. Lewis, acting president of the college. Students whose deportment or class work is not satisfactory are not likely to be continued in student labor. The most desirable and responsible positions are naturally assigned to those needy students who have been in the institution longest and who have demonstrated their need and ability. Students, therefore, may find it rather difficult to obtain all the work they desire during their freshman year; as a matter of fact, however, any student who is capable of doing a variety of things, and who is a competent workman, usually finds little difficulty in obtaining all the work that he can do from the outset.

Special Notice to Needy Students. — In the last few years the demand for paid labor on the part of new students has far exceeded the amount of employment that the college can offer. The college cannot promise work to any student, particularly to freshmen; it accordingly urges prospective students who are dependent entirely upon their own efforts not to undertake the course before they have earned enough money to carry them through, or nearly through, the first year.

Scholarships.

The Ward Fund.

The so-called Ward Fund is available for the assistance of needy boys from Hampshire County attending the Massachusetts Agricultural College. This fund is administered by a Board of Trustees not connected with the College. Application blanks for assistance from this fund may be secured from the Treasurer of the College.

The Frederick G. Crane Fund.

The family of the late Frederick G. Crane of Dalton has presented to the Massachusetts Agricultural College a gift of $25,000 to establish a fund in memory of Frederick G. Crane, the income therefrom to be expended by the Trustees in aid of worthy undergraduate four-year students of limited financial resources attending the College, preference being given to residents of Berkshire County. Grants made from this fund are to be known as Frederick G. Crane Scholarships.

Applications.

All applications for loans or gifts from this fund should be made to the President, Massachusetts Agricultural College, Amherst, Mass., under whose direction an investigation will be made of the merits of the applicants. The purpose of this investigation will be to insure that the aid is extended to students whose parents are in such financial condition that assistance is necessary in order to insure a college education for the applicants; that it is extended only to students who propose to complete their college education at the Massachusetts Agricultural College; and that it is given to those whose character and scholarship record justifies the assistance available through this fund.

Aid to Freshmen.

Grants from the Crane Fund will be made to freshmen in the form of loans supported by notes bearing indorsements satisfactory to the President of the College. These notes will bear interest and will be negotiable. The College, however, will at its discretion cancel these notes at the end of one year if the scholarship record of the student, his character, and his plans for the future appear to the President so to warrant.

Aid to Sophomores.

Grants will be made to sophomores either on the plan outlined for freshmen as given above or on the plan outlined for juniors and seniors as given below.

Aid to Juniors and Seniors.

Grants to juniors and seniors will usually be in the form of gifts and will be awarded with consideration of the need, of the scholarship, and of the character of the applicant.

Amount of Grants.

The amount of grants from this fund, made either as loans or as gifts, will be determined by the need of the applicant and by the amount of money available in the fund. Generally one may expect to receive from $50 to $300 per year.

General Considerations.

In harmony with the provisions of the bequest, preference will be given to applicants for aid who reside in Berkshire County; but the cases of deserving students from other parts of the State will be given due consideration, and such students may under certain conditions be aided in preference to the residents of Berkshire County.

Awards will be made to girls and boys without discrimination.

Memorial Hall.

Soon after the close of the World War the alumni, students, faculty and friends of the college subscribed $150,000 for the erection of a soldier memorial building to be placed on the college campus. This building was completed in the summer

of 1921. It is designed to serve as headquarters for the student activities, and as the center of the social life of the institution.

In the basement are bowling alleys, pool tables, a store, post office and barber shop. On the main floor are eight offices for leaders of various student activities, a large reading room, and a beautiful memorial room in which is found the tablet bearing the names of the sons of the college who gave their lives in the great war. On the second floor is an auditorium seating 350 persons. This room is also used for college dances.

Student Accounts.

The following rules are enforced concerning student accounts:

No student will be allowed to graduate until all bills due the institution from him are paid.

College charges, such as room rent, laboratory fees and tuition, must be paid in advance, at the beginning of each term. This rule is strictly adhered to, and no student will be allowed to complete his registration until such payments are made.

Every student boarding at Draper Hall is required to pay at the beginning of each term at least one month's board in advance; and no student will be allowed to continue to board at Draper Hall if at any time during the term he is more than one week in arrears in his payment for board.

All money due for student labor shall at the discretion of the treasurer of the college be applied on account toward any bills that a student may owe to the institution.

Honor Council.

All tests and examinations are conducted under the honor system, which is administered by an Honor Council chosen by the students. Recommendations for discipline are made to the President of the college by the Honor Council.

Student Relations.

The customary high standard of college men in honor, manliness, self-respect and consideration for the rights of others constitutes the standards of student deportment.

The privileges of the college may be withdrawn from any student at any time, if such action is deemed advisable.

It should be understood that the college, acting through its president or any administrative officer designated by him, distinctly reserves the right, not only to suspend or dismiss students, but also to name conditions under which students may remain in the institution. For example, if a student is not doing creditable work he may not only be disciplined but he may also be required to meet certain prescribed conditions in respect to his studies, even though under the foregoing rules his status as a student be not affected. The same provision applies equally to the matter of absences ("cuts"). According to the rules a student is allowed a certain percentage of absences from class and other exercises. This permission, which implies a privilege and not a right, may be withdrawn at any time for any cause.

Similarly, also, it applies to participation in student activities. Though this will ordinarily be governed by the rules as already laid down, yet, if in the judgment of the college authorities a student is neglecting his work on account of these activities, the privilege of participating in them may be withdrawn for such time as is considered necessary. Moreover, it may be withdrawn as a punishment for misconduct. Prospective students or their parents may, upon application, obtain a copy of the faculty rules governing student relations to the college.

Infirmary.

The college maintains an infirmary for the care of sick or injured students.

The buildings now available for this purpose are quite inadequate for the needs of the institution, and it is hoped that in the near future other buildings of this

kind may be erected and the general equipment somewhat amplified. At present two small buildings, built especially for hospital purposes, are used for the infirmary.

The following statement outlines the plan followed in the management of the infirmary with respect to students: —

Management of the Infirmary.

Supervision.

1. The infirmary is under the *general supervision* of Prof. Charles E. Marshall, who is designated as Supervisor of the Infirmary. A resident nurse is in *immediate* charge of the infirmary.

Use of Infirmary.

2. Students are urged to go to the infirmary at any time that they are in need of the services rendered by the resident nurse or by a town physician. Inasmuch as the physical director gives special attention to all student diseases, it is to be expected that the majority of the students will go to the infirmary at his suggestion. This understanding, however, should in no way deter students from going to the infirmary voluntarily at any time.

General Health.

3. Students are urged to consult the physical director or the resident nurse immediately when signs of physical disorder appear. Severe attacks of cold or other forms of illness can usually be avoided if treatment is administered in the incipient stage. The purpose of the infirmary is to help maintain the general good health of the students, as well as to furnish a suitable place for professional attention in cases of severe illness or accident.

General Fee.

4. The infirmary fee will be at the rate of $2 a day, and will be charged when one or more meals are obtained at the infirmary, or when the student remains at the infirmary for one or more nights. A nominal charge will be made to outpatients for miscellaneous treatment of a minor character.

Additional Expenses.

5. In addition to the fee charged, as specified in paragraph 4, the following additional expenses will be charged to the patient: —

(*a*) *Nurses.* — In case a special nurse is required for the proper care of an individual, the services and board of this nurse will be paid by the patient. Such a nurse will be under the general supervision of the resident nurse.

(*b*) *Professional Service.* — If a student requires medical attention by a physician, he will be required to select his physician and become responsible for fees charged by the physician.

(*c*) *Supplies.* — Special medical supplies prescribed by a physician or nurse will be charged to the patient.

(*d*) *Laundry.* — Expense for personal laundry incurred by students while in the infirmary will be charged to the individual student.

B. COLLEGE ACTIVITIES.

General Exercises.

Chapel exercises are held two mornings each week. On Thursdays during the fall term, and on Wednesdays during the winter and spring terms, an afternoon assembly is held, to which some prominent layman or professional man is invited to speak. The object of these assemblies is to bring to the students discussions of topics of present-day interest. A special chapel service on Sunday is held during

the winter months. Students are required to attend these general exercises, although the president is authorized to excuse from chapel any student who may object to attendance thereon because of his religious scruples, provided his request for excuse therefrom is endorsed by his parent or guardian.

Student Activities.

A large number of student organizations furnish opportunity to students for work and leadership.

The Massachusetts Agricultural College Social Union was established in 1907. All students become members of the union by paying a small fee. In the fall and winter months the union gives a series of entertainments, free to students and faculty.

The College Senate is composed of representatives of the junior and senior classes. This body serves as a general director of undergraduate conduct, and represents before the faculty the interests of the student body.

The Young Men's Christian Association and the Young Women's Christian Association are active both socially and religiously. A Catholic club has also been organized.

Intercollegiate and intermural athletic contests are held throughout the year in the leading sports, including football, baseball, track, hockey and basketball. The athletic board, composed of alumni, faculty and students, has charge of finances, schedules, and general policies governing athletics.

The musical clubs include an orchestra and a glee club. These give a number of concerts, usually followed by dancing, during the year, both in Amherst and on tour. A dramatic club, The Roister Doisters, present annually a revue and two plays, one in connection with the promenade and the other at commencement. There are, besides the declamation and oratorical prize contests, both underclass and intercollegiate debates. The college is a member of a quadrangular league with Maine, New Hampshire, and Vermont. The college publications are the "Massachusetts Collegian," the weekly newspaper; "The Index," the year book; "The Squib," a comic magazine; and "The Alumni Bulletin," issued from the office of the alumni secretary. Judging teams under the direction of the departments of Animal Husbandry, Poultry Husbandry, and Pomology compete with teams from other agricultural colleges. The Academic Activities Board, composed of alumni, faculty and students, has charge of the finances, schedules, etc., of the various clubs and publications.

A rifle club has been organized for a few years. Teams representing this club have repeatedly won the intercollegiate championship of the country, both in indoor and outdoor contests.

C. ACADEMIC AND DEPARTMENTAL.

Degrees.

Those who complete a four-year course receive the degree of bachelor of science. The fee for graduation from the college is $5.

Graduate students who complete the assigned courses will receive the degree of master of science upon the payment of a fee of $10. Credit may sometimes be allowed towards this degree for teaching or other advanced work done in some department of the college.

Graduate students who complete the required three-year course of study, and present a satisfactory thesis, will be granted the degree of doctor of philosophy. The diploma fee in this instance is $25.

Those to whom degrees are awarded must present themselves in person at commencement to receive them. No honorary degrees are conferrred.

The honorary fraternity of Phi Kappa Phi has a chapter at the agricultural college. Students are elected to membership to this fraternity on the basis of scholarship. Elections are made from the highest tenth of the senior class who have attained an average grade of at least 85 per cent during their college course.

Awards and Prizes, 1924.

Grinnell Prizes. — The Grinnell prizes, given by the Hon. William Claflin of Boston in honor of George B. Grinnell, Esq. of New York, to those members of the senior class who pass the best, second best and third best examinations, oral and written, in theoretical and practical agriculture, were awarded as follows: —

First Prize, Kenneth Wallace Sims.

Second Prize, Alfred Fullick Gay.

Third Prize, Luther Leonard Hayden, Jr.

Public Speaking. — The Burnham prizes were awarded to the students delivering the best and second best declamations, as follows: —

First Prize, Herman Eames Pickens.

Second Prize, Robert C. Ames.

Flint Prizes. — The Flint prize, awarded to the student delivering the best oration, as follows: —

No contest in 1924.

Hills Prizes. — The Hills Prizes for the best herbaria were awarded as follows: —

First Prize, John T. Perry.

Second Prize, Mrs. Mary T. Boyd.

Southern Alumni Baseball Cup. — For the best all-round Baseball player during the season of 1924 the Southern Alumni baseball cup was awarded to Arthur Chester Nicoll, 1924.

Allan Leon Pond Memorial Medal, for Excellence in Football. — The Allan Leon Pond memorial medal for general excellence in football was awarded to Sterling Myrick, 1924. This medal is in memory of Allan Leon Pond of the class of 1920, who died Feb. 26, 1920.

Athletic Prize. — The trustees of the Frederick Cornelius Eldred Memorial Athletic Fund offered a prize of fifty dollars to that member of the senior class who showed the most constructive suggestions for the physical development of the student body, with particular reference to that portion which does not participate in the major sports. Awarded to Sterling Myrick, 1924.

Degrees Conferred — 1924.

Master of Science (M.Sc.).

Archibald, John Geddie, B.S.A., Ontario Agricultural College	Amherst.
Bromley, Stanley Willard, B.Sc., Massachusetts Agricultural College	Southbridge.
Mack, Warren Bryan, B.Sc., Pennsylvania State College	Flicksville, Pa.
Mooney, Raymond Alson, B.Sc., Massachusetts Agricultural College	Plattsburg, N. Y.

Master of Landscape Architecture (M.L.A.).

Rogers, Roland Winsor, B.Sc., Massachusetts Agricultural College	Amherst.

Doctor of Philosophy (Ph.D.).

Freeborn, Stanley Barron, B.Sc., Massachusetts Agricultural College	Berkeley, California.

Bachelor of Science (B.Sc.).

Barrows, Robert Arthur	Quincy.
Bartlett, Frederick Sheldon	Westfield.
Bartlett, Perry Goodell	Holyoke.
Bartlett, Warren Leslie	Boston.
Belden, Clifford Luce	Bradstreet.
Bike, Edward Louis	Westfield.
Bittinger, Richard	Northfield.
Bowes, Charles Atwell	Worcester.
Brunner, Fred, Jr.	Cranbury, N. J.
Burbeck, Joseph Howard	Peabody.
Cahalane, Victor Harrison	Charleston, N. H.
Carpenter, Earle Stanton	Rehoboth.
Chase, Theodore Martin	Livermore Falls, Me.
Cromack, Earl Augustus	Shelburne Falls.
Darling, Robert Martin	Cambridge.
Davis, Howard Halsey	Brockton.
Deuel, Charles Frederick, 2d.	Amherst.
Dresser, Allen Lucius	Amherst.
Elliott, James Alexander	Summit, N. J.
Epps, Martha Belle Scott	Winchendon.
Fenton, John Michael	Amherst.
Fernald, Leland Hoyt	Arlington.
Flint, Ruth Guild	Allston.
Foley, Mary Joanna	Worcester.
Frost, Sherman Clark	Cambridge.
Gadsby, James Herbert	North Adams.
Garretson, Alfred Corwin	Bound Brook, N. J.
Gay, Alfred Fullick	Groton.
Geiger, Aimee Suzanne	Pepperell.
Goldsmith, Eliot Gray	Brookline.
Goldstein, Joseph	Lynn.
Grieve, Alexander Watson	Dorchester.
Gryzwacz, Patrick Louis	Ware.
Haskell, Malcolm Rawson	Amherst.
Hayden, Luther Leonard, Jr.	Brookville.
Hescock, Robert Eddy	Amherst.
Hill, Carroll Victor	Worcester.
Holway, Clarence Warren	Putney, Vt.
Isaac, Carl Frederick	Brighton.
James, Locke LeBaron	West Bridgewater.
Kane, Edward Anthony	Westfield.
Keith, Clifford Woodworth	East Providence, R. I.
King, Rosewell Howard	Millville.
Lamb, Eric Franklin	Waban.
Lane, Wilfred Craig	Fitchburg.
Leland, Allen Sanford	East Bridgewater.
Loring, Kenneth Stockwell	Melrose Highlands.
MacAffee, Norman Hoar	Cambridge.
Meserve, Charles Arthur	Amherst.
Morris, Walter Markley	Amherst.
Myrick, Sterling	Longmeadow.
Nelson, Carl Olaf	Gloucester.
Nicoll, Arthur Chester	Quincy.
Norwood, Howard Lester	Boston.

Noyes, Russell	Newton Centre.
Percival, Gordon Pittinger	Medfield.
Perry, Chauncy Valentine	Waltham.
Perry, John Tuttle	Waltham.
Pierce, Arthur Edwin	Newtonville.
Porges, Nandor	Hyde Park.
Pratt, Wallace Francis	Rockland.
Read, John Gammons	Springfield.
Rhodes, Winthrop Gordon	Waban.
Ricker, Chester Sewall	Worcester.
Salman, Kenneth Allen	Needham.
Schaffer, Carlton Hill	Ashfield.
Sellers, Wendell Folsom	Melrose.
Shepard, Harold Henry	Athol.
Sims, Kenneth Wallace	South Boston.
Smith, Richard Burr	Greenfield.
Steele, Charles Wasser	Marblehead.
Steere, Robert Ernest	Chepachet, R. I.
Stevenson, Harold Dudley	Camden, Me.
Tewhill, Charles James	Florence.
Varnum, Thomas, Jr.	Lowell.
Walker, Judson Newcombe	Marlboro, N. H.
Waugh, Albert Edmund	Amherst.
Weatherwax, Howard Erle	Greenfield.
White, Samuel Henry	Orange.
Whitman, Chester Edgerly	Milton, N. H.
Whitney, Richard Augustine	Brooklyn, N. Y.
Whitney, Will Alvah	Taunton.
Williams, James Lowell	Sunderland.
Witt, Earl Maynard	Belchertown.
Wood, Ruth Millicent	Hathorne.
Wood, William Wilson	Barre Plains.
Woodworth, Robert Hugo	Newton.

Bachelor of Vocational Agriculture, (B.Voc.Agri.).

Regan, Leon Ashley	Walpole.

Registration, 1924–25.

As of November 1, 1924.

Graduate Students.

Ayers, Theodore T. . . . . Old Forge, Pa.
B.Sc., Pennsylvania State College.
Bailey, John S. . . . . Amherst.
B.Sc., Michigan Agricultural College.
M.Sc., Iowa State College.
Bartlett, Frederick S. . . . . Westfield.
B.Sc., Massachusetts Agricultural College.
Bird, Arthur C. . . . . Waterbury, Conn.
B.Sc., Connecticut Agricultural College.
Cassidy, Morton H. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Chase, Eleanor F. . . . . Amesbury.
B.Sc., Massachusetts Agricultural College.
Cupery, Martin E. . . . . Friesland, Wis.
A.B., Hope College.
Dickinson, Lawrence S. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Doran, William L. . . . . Lexington.
B.Sc., Massachusetts Agricultural College.
M.Sc., Massachusetts Agricultural College.
Foley, Mary J. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
French, Arthur P. . . . . Amherst.
B.Sc., Ohio State University.
M.Sc., Massachusetts Agricultural College.
Garabedian, Hovanes . . . . Smyrna, Asia Minor.
B.A., International College, Smyrna.
Garvey, Mary E. M. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Gibbard, James, Jr. . . . . Toronto, Ontario, Canada.
B.S.A., Ontario Agricultural College, Toronto University.
Gilligan, Gerald M. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Gray, T. Davis . . . . Morgantown, West Va.
B.Sc., Maryland Agricultural College.
Grieve, Alexander W. . . . . Dorchester.
B Sc., Massachusetts Agricultural College.
Hallowell, Elizabeth . . . . Amherst.
A.B., A.M., Boston University.
Hays, Frank A. . . . . Amherst.
B.Sc., Oklahoma A. & M. College.
M.A., University of Nebraska.
Ph.D., Iowa State College.
Hopkins, Elizabeth F. . . . . Canandaigua, N. Y.
A.B., Vassar College.
Jones, Willard P. . . . . Amherst.
B.Sc., University of Wisconsin.
Louwsma, Henry . . . . Zeeland, Mich.
A.B., Hope College.
McDonnell, Anna H. . . . . Florence.
A.B., Smith College.
Mayo, William I., Jr. . . . . Northampton.
B.Sc., Massachusetts Agricultural College.
Merritt, Lucius A., Jr. . . . . Williamsburg.
B.Sc., Trinity College.
Morgan, Ezra L. . . . . Columbia, Mo.
A.B., McKendree College.
M.A., University of Wisconsin.
Mortensen, Harry T. . . . . Rodney, Mich.
B.Sc., Michigan Agricultural College.
Muller, Richard T. . . . . Amherst.
B.Sc., Cornell University.
M Sc., University of Maine.
Patch, Henry L. . . . . Wenham.
B.Sc., Massachusetts Agricultural College.
Patton, John W. . . . . Amherst.
D.V.M., Texas A. & M. College.
M.Sc., Kansas State College.
Pendleton, Harlow L. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Percival, Gordon P. . . . . Medfield.
B.Sc., Massachusetts Agricultural College.

Prescott, Glenn C. . . . . Florence.
B.A., University of Maine.
Pulley, Marion G. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Raleigh, George J. . . . . Amherst.
B.Sc. in Agr., Kansas State Agricultural College.
M.Sc., University of Nebraska.
Redman, Ralph W. . . . . Amherst.
B.Sc., University of Maine.
Reed, James P. . . . . Hadley.
B.Sc., University of Vermont.
Rice, Victor A. . . . . Amherst.
B.Sc., North Carolina State College.
M.Agr., Massachusetts Agricultural College.
Rikert, Carroll . . . . Mount Hermon.
B.A., Harvard University.
Ring, Gordon C. . . . . Amherst.
B.Sc., M.A., Wesleyan University.
Rowell, Elwyn J. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Sanborn, Joseph R. . . . . North Amherst.
B.Sc., Massachusetts Agricultural College.
Sanborn, Ruby . . . . Amherst.
A.B., Mount Holyoke College.
Sawtelle, Donald W. . . . . Amherst.
B.Sc., University of Maine.
M.Sc., University of Wisconsin.
Sawtelle, Emily H. . . . . Amherst.
B.A., M.A., New York State College for Teachers.
Sessions, Alwyn C. . . . . Logan, Utah.
B.Sc., Utah Agricultural College.
Seymour, Frank C. . . . . North Amherst.
A.B., Harvard University.
B.D., Union Theological Seminary.
Shepard, Harold H. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Simmons, Kenneth B. . . . . Rowesville, S. C.
B.Sc., Clemson College.
Smith, Richard W., Jr. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Snyder, Grant B. . . . . Amherst.
B.S.A., Ontario Agricultural College.
Steck, Harold W. . . . . Bethel, Conn.
B.Sc., Connecticut Agricultural College.
Street, Orman E. . . . . Revillo, S. Dak.
B.Sc., South Dakota State College.
Sumbardo, Alexander H. . . . . Seattle, Wash.
B.Sc. in Agr., Washington State College.
Van Meter, Ralph A. . . . . Amherst.
B.Sc., Ohio State University.
Waugh, Albert E. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Wharton, Denis R. A. . . . . Port of Spain, Trinidad.
B.S.A., Ontario Agricultural College.
Willard, John D. . . . . Amherst.
B.A., Amherst College.
Wofford, Gus C. . . . . Laurens, S. C.
B.Sc., Clemson College.
Worthley, Harlan N. . . . . Amherst.
B.Sc., M.Sc., Massachusetts Agricultural College.
Yaxis, T. George . . . . Amherst.
B.Sc., New Hampshire State University.
M.Sc., Cornell University.
Yount, Hubert W. . . . . Amherst.
B.Sc.Agr., Ohio State University.
M.Sc., Massachusetts Agricultural College.

Registered after the Catalogue for 1923 was published.

Ayers, Theodore T. . . . . Old Forge, Pa.
B.Sc., Pennsylvania State College.
Brown, Edgar M. . . . . Hartford, Conn.
B.Sc., Massachusetts Agricultural College.
Gordon, Howard R. . . . . Ipswich.
B.Sc., Massachusetts Agricultural College.
Lacroix, Donald S. . . . . Amherst.
B.Sc., Massachusetts Agricultural College.
Merritt, Lucius A., Jr. . . . . Williamsburg.
B.Sc., Trinity College.
Nickerson, Emelyn G. . . . . Provincetown.
B.A., Wellesley College.
Patch, Henry L. . . . . Wenham.
B.Sc., Massachusetts Agricultural College.
Richardson, Lewis E. . . . . Millis.
B.Sc., Massachusetts Agricultural College.
Richmond, E. Avery . . . . Brockton.
B.Sc., Dartmouth College.
M.A., Cornell University.

Class of 1925.

Armstrong, Bradford	Kensington, Md.	Q. T. V.
Barnes, Adrian Douglas	South Weymouth	Q. T. V.
Bean, Francis Irving	Bradford	Q. T. V.
Benoit, Helen Anna	Amherst	16 Belchertown Road.
Binner, Roger Stokehill	Amherst	Amherst House.
Bray, Ralph Hastings	Framingham	Sigma Phi Epsilon.
Burhoe, Sumner Othniel	Westborough	42 Lincoln Avenue.
Cahill, Carl Winfield	Newburyport	Kappa Sigma.
Casey, Alice Rita	Fall River	Abigail Adams House.
Cassano, Joseph [1]	Groveland	Q. T. V.
Church, George Lyle	Dorchester	Alpha Gamma Rho.
Cleaves, Leighton Greenwood	Gardner	Phi Sigma Kappa.
Cooke, Robert Gordon	Atlantic	Alpha Sigma Phi.
Corwin, Emil Joseph	Winthrop	13 South College.
Crosby, John Samuel	Arlington	Phi Sigma Kappa.
Currier, Leland Little	Marblehead	Alpha Gamma Rho.
Davis, Osborne Ozro	Belchertown	20 South College.
DeVito, Dominick	Roxbury	Kappa Epsilon.
Duffy, Leo Francis	Springfield	Kappa Epsilon.
Emery, George Edward	Marlborough	Sigma Phi Epsilon.
Ferranti, Edmund Tony	West Bridgewater	Lambda Chi Alpha.
Frost, Willard Chamberlain	Milford	Theta Chi.
Gilbert, Chauncey McLean	North Amherst	Meadow Street.
Gleason, Harold Albert	Chester	Phi Sigma Kappa.
Gordon, Samuel Francis	Ipswich	Lambda Chi Alpha.
Gordon, Solomon	Boston	13 South College.
Grover, Walter Champion	Bernardston	Phi Sigma Kappa.
Guterman, Carl Edward Frederick	Springfield	Kappa Sigma.
Haeussler, Gilbert Julius	Springfield	Kappa Sigma.
Hanscomb, George Wilmont	North Attleborough	Lambda Chi Alpha.
Harris, Clarence Albert	Utica, N. Y.	16 South College.
Holbrook, Lester Morse	Fairhaven	Lambda Chi Alpha.
Holteen, John Gunnar	Quincy	Kappa Gamma Phi.
Hyde, John Worthington	Amherst	79 Pleasant Street.
Ingraham, Edward Forster	Millis	Sigma Phi Epsilon.
Jack, Melvin Clifton	Amherst	16 Hallock Street.
Kakavas, James Christo	Lowell	2 North College.
Keith, Lewis Hayden	Bridgewater	Kappa Sigma.
Kennedy, Lowell Francis	Cambridge	Q. T. V.
Lacey, John Sebastian	Holyoke	Alpha Sigma Phi.
Lavallee, Louis Palmer	Worcester	5 Nutting Avenue.
Lord, John Frederic	Methuen	Alpha Sigma Phi.
Love, Andrew Wyllie	Auburn	Alpha Gamma Rho.
Lunt, Samuel Wilde	Cumberland Center, Me.	Kappa Sigma.
Mahoney, Walter Francis	Millville	Alpha Sigma Phi.
Marx, Herbert John	Holyoke	Kappa Epsilon.
McGeoch, Charles Ryerson	New Bedford	Kappa Epsilon.
Mouradian, Garabed Kevork	Bridgewater	Q. T. V.
Moxon, David	Holyoke	Kappa Epsilon.
Nelson, Paul Redfield	Holyoke	15 Phillips Street.
O'Connor, Arthur Maxwell	Amherst	35 Pleasant Street.
Oliver, Charles Frank, Jr.	Brockton	Lambda Chi Alpha.
Parker, Donald Llewellyn	North Adams	Sigma Phi Epsilon.
Peirce, Veasey	Dorchester	Phi Sigma Kappa.
Peltier, Xavier Paul	Spencer	Q. T. V.
Poey, Frederick	Boston	10 South College.
Reynolds, Joseph Sagar	Attleboro	Theta Chi.
Roberts, Verne Edward	Amherst	13 Amity Street.
Root, Frank Edson	Bernardston	Alpha Gamma Rho.
Ross, Charles Frederick	Lee	Sigma Phi Epsilon.
Ross, Donald Ernest	Amherst	13 Woodside Ave.
Rowley, Harold Frederick	West Wareham	15 Hallock Street.
Samuels, Samuel Bernhard	Holyoke	14 South College.
Sazama, Robert Francis	Northampton	Alpha Sigma Phi.
Sheridan, Irwin Scott	Mansfield	Alpha Gamma Rho.
Shumway, George Francis	Monson	Physics Building.
Simpson, Gilbert	Holyoke	27 Fearing Street.
Slack, Marion Florence	Allston	Abigail Adams House.
Slowen, William Arnold	Shelburne Falls	Physics Building.
Smith, Emily Greenwood	Stockbridge	Abigail Adams House.
Smith, Myron Newton	Millbury	Phi Sigma Kappa.
Sprague, Dudley deRochemont	Melrose	16 South College.
Taube, Gustave	Holyoke	15 South College.
Taylor, Milton Wight	Chatham	Kappa Sigma.
Templeton, Robert James	Boston	Lambda Chi Alpha.
Tower, Emerson	Meshanticut, R. I.	Lambda Chi Alpha.
Ward, Gordon Hugh	Englewood, N. J.	Alpha Gamma Rho.
Waterbury, Arthur Logan	Medford	Sigma Phi Epsilon.
Whittum, Walter Willard	Springfield	Kappa Gamma Phi.
Wilcox, Stanley Dewey	Springfield	Kappa Gamma Phi.
Wilder, Frank Harris	Sterling Jct.	Phi Sigma Kappa.
Woodbury, Samuel Lawrence	Springfield	Alpha Gamma Rho.
Zwisler, Frederick Fisher	Holyoke	Kappa Epsilon.

[1] Candidate for degree of bachelor of vocational agriculture.

CLASS OF 1926.

Albertini, Paul Flanders	Billerica	Kappa Epsilon.
Anderson, Leslie Clayton	East Bridgewater	Lambda Chi Alpha.
Baker, Francis Everett	Hopkinton	Phi Sigma Kappa.
Baker, Frederic Allen	Springfield	Phi Sigma Kappa.
Barber Elmer Everett	Jamaica Plain	Kappa Epsilon.
Barnes, Russell Norris	Wallingford, Conn.	Sigma Phi Epsilon.
Bartlett, Herbert Franklin	West Springfield	Alpha Gamma Rho.
Block, Harry William	East Boston	13 South College.
Bosworth, Marguerite Rose	Holyoke	Abigail Adams House.
Bosworth, Maude Elinor	Holyoke	Abigail Adams House.
Bower, James, Jr.	Holyoke	Kappa Epsilon.
Boyd, Mary Turck	Jacksonville, Fla.	Abigail Adams House.
Brougham, Earle Gordon	Holyoke	Alpha Sigma Phi.
Bruorton, Earle Wallace	Reading	Sigma Phi Epsilon.
Buckley, Arthur Vincent	Natick	Kappa Sigma.
Budge, William Karl	Mattapan	3 North College.
Burnham, James Erastus	Springfield	Lambda Chi Alpha.
Burt, Stanley Lyman	Easthampton	10 South College.
Cassidy, Marion Stewart	Wellesley	Abigail Adams House.
Cormier, Francis Joseph	Newtonville	Phi Sigma Kappa.
Couhig, Philip Henry	Beverly	Q. T. V.
Cromack, Aaron Field	Shelburne Falls	Theta Chi.
Davenport, Preston Julian [1]	Shelburne Falls	17 Fearing Street.
Davis, Evelyn Louise	Springfield	Abigail Adams House.
Dean, Lecil Wallace	West Palm Beach, Fla.	12 South College.
Dick, Ernest Albert	Lawrence	Alpha Gamma Rho.
Dodge, Eliot Perkins	Beverly	Theta Chi.
Doolittle, Alden Hartwell	Northfield	Aggie Inn.
Douglass, Earle Lawrence	Springfield	Alpha Gamma Rho.
Dow, Philip Norman	Bolton	Alpha Gamma Rho.
Drake, Dorothy Madeline	Cambridge	Abigail Adams House.
Ducharme, Lucien Henry	Holyoke	Kappa Epsilon.
Durkee, Lewis Leland	Beverly	Theta Chi.
Fessenden, Richard William	Middleborough	Alpha Gamma Rho.
Fish, Donald Otis	Amherst	Kappa Sigma.
Fitzgerald, Lillian Alice	Holyoke	Abigail Adams.
Flynn, Alan Foster	Newton	Kappa Epsilon.
Ford, William Warner	Dalton	Stockbridge Hall.
Fraser, Carl Arthur	Westborough	Theta Chi.
Fraser, Harry Edward	Jamaica Plain	Kappa Sigma.
Galbraith, Leo Lake	South Hadley	Kappa Gamma Phi.
Gavin, Linus Arthur	Natick	Kappa Sigma.
Goodwin, Marvin Warren	Reading	Alpha Sigma Phi.
Goren, Louis	Chelsea	14 South College.
Grant, Theodore James	Auburndale	Theta Chi.
Grayson, Herbert	Milford	Alpha Sigma Phi.
Greenwood, Elliott Kelton	Hubbardston	M. A. C. Farmhouse.
Gustafson, Alton Herman	Campello	Clark Hall.
Hatch, Harold Curtis	Melrose	Alpha Gamma Rho.
Haynes, Walter Lincoln	Springfield	Phi Sigma Kappa.
Hill, Arthur Blair	Walpole	Phi Sigma Kappa.
Hollingworth, Duncalf Wright	Providence, R. I.	Lambda Chi Alpha.
Howes, Stanley Edward	Brimfield	Alpha Gamma Rho.
Huke, Barbara Allen	South Hadley Falls	Abigail Adams House.
Jameson, Matthew	Everett	Kappa Epsilon.
Jensen, Harold Stery	Westfield	Sigma Phi Epsilon.
Johnson, Philip Gordon	Amherst	West Street.
Jones, Alvah Wesley	Salisbury	Kappa Gamma Phi.
Jones, Lawrence Lakin	Campello	7 North College.
Kafafian, Sarkis Petros	Amherst	11 North College.
Kelso, George	Reading	Sigma Phi Epsilon.
Lambert, John Ford	Gleasondale	Lambda Chi Alpha.
Langshaw, Hatton, Jr.	Fairhaven	Alpha Sigma Phi.
Larsinos, George John	Westfield	17 North College.
Lindskog, Herbert Alf	Roxbury	Kappa Epsilon.
MacMasters, Majel Margaret	Ashburnham	Abigail Adams House.
Mann, Albert Irving	Dalton	Sigma Phi Epsilon.
McNamara, Charles Henry	Stoughton	Kappa Sigma.
Meserve, George Donald	Hudson	Lambda Chi Alpha.
Moberg, Herbert Elof	Brockton	Alpha Sigma Phi.
Moran, John	Amherst	51 Northampton Road.
Needham, Basil Arthur	Taunton	Sigma Phi Epsilon.
Nichols, Chester Willard	Natick	32 North Prospect Street.
Nickerson, Elsie Elizabeth	East Boston	Abigail Adams House.
Norcross, Roy Ellis	Brimfield	16 South College.
Novick, Leo Altschuler	Amherst	56 Pleasant Street.
Otto, Raymond Herman	Lawrence	Kappa Gamma Phi.
Palmer, Cary Davis	Grafton, Vt.	3 North College.
Pomeroy, Elizabeth Clark	Longmeadow	Abigail Adams House.
Potter, Royal Wesley	Providence, R. I.	Phi Sigma Kappa.
Putnam, Ruth Evelyn	Greenfield	Abigail Adams House.
Rainault, Ernest	Holyoke	Kappa Epsilon.
Reed, Charles Porter	West Bridgewater	Lambda Chi Alpha.

[1] Candidate for degree of bachelor of vocational agriculture.

Ribero, Edwin Francis	Amherst	29 Northampton Road.
Richards, James Marsh	Springfield	Phi Sigma Kappa.
Richardson, Henry Howe	Millis	Phi Sigma Kappa.
Robinson, Clifton Fairbanks	Newtonville	Q. T. V.
Rowen, Edward Joseph	Westfield	Sigma Phi Epsilon.
Sawyer, Roland Damon, Jr.	Ware	Aggie Inn.
Shea, Margaret Catherine	Holyoke	Abigail Adams House.
Simonds, Henry Erving	Winchester	Lambda Chi Alpha.
Smiley, Ray Guild	Worcester	Alpha Sigma Phi.
Smith, Margaret Park	Taunton	Abigail Adams House.
Smith, Raymond Ellingwood	Salem	Mt. Pleasant.
Sniffen, Loren Fillow	Westport, Conn.	84 Pleasant Street.
Spooner, Raymond Hildreth	Brimfield	Clark Hall.
Stevens, Alvin Gay	Needham	Kappa Sigma.
Stopford, William Turner	Newtonville	Theta Chi.
Sullivan, Charles Noyes	Fall River	Alpha Sigma Phi.
Sullivan, Donald Clifford	Amherst	25 Gray Street.
Temple, John Burrington	Shelburne Falls	17 Fearing Street.
Tetreault, Albert Joseph	New Bedford	Sigma Phi Epsilon.
Thompson, Gerald Thayer	Shelburne Falls	Theta Chi.
Thurlow, George Harold	West Newbury	Kappa Sigma.
Tucker, Edwin Locke	Baldwinsville	Kappa Gamma Phi.
Tulenko, John	Sunderland	Sunderland.
Turner, Charles Edgar	Springfield	8 Mt. Pleasant.
Walsh, Philip Baker	Amherst	4 Chestnut Street.
Warren, Francis Walter	Stow	Theta Chi.
Wheeler, Ellsworth Haines	Bolton	Alpha Gamma Rho.
White, Earl Martin	Abington	Kappa Sigma.
White, Montague	West Hartford, Conn.	Q. T. V.
Williams, Donald Reed	Northfield	Alpha Sigma Phi.

CLASS OF 1927.

Adams, James Prescott	Medway	Q. T. V.
Ames, Robert Call	Vineyard Haven	46 Pleasant Street.
Ames, Winthrop Ashley	Vineyard Haven	32 North Prospect Street.
Amstein, William Gerald	South Deerfield	Q. T. V.
Anderson, Andrew Bremer	Hudson	Lambda Chi Alpha.
Baker, Philip Woodell	Amherst	124 West Street.
Barney, Laurence Hillman, Jr.	New Bedford	Phi Sigma Kappa.
Belden, Sanford Oscar [1]	Bradstreet	Kappa Sigma.
Berry, George Robert	Northampton	10 North College.
Biron, Raphael Alfred	Amesbury	Theta Chi.
Black, Lewis Herbert	Williamsburg	Alpha Gamma Rho.
Boden, Frank Joseph	North Wilbraham	29 North Prospect Street.
Botulinski, Frank John	Boston	Stockbridge Hall.
Bovarnick, Max	Dorchester	56 Pleasant Street.
Bray, Frederick Roland	Amherst	5 Hitchcock Street.
Briggs, Lawrence Elliott	Rockland	Theta Chi.
Brooks, William Henry, 2d	Holyoke	Phi Sigma Kappa.
Bruce, Frances Clara	Easthampton	Abigail Adams House.
Buckler, Ella Maud [2]	Pittsfield	Abigail Adams House.
Burrell, Robert Wallace	Abington	Theta Chi.
Carlson, Oscar Ernest [2]	Boston	66 Pleasant Street.
Cartwright, Calton Oliver [1]	Northampton	Kappa Epsilon.
Chamberlain, Alexander Rodger	Springfield	Lambda Chi Alpha.
Clagg, Charles Floyd	Everett	Alpha Gamma Rho.
Cobb, Roger Madison	Wrentham	15 Hallock Street.
Connell, Edward Anthony	Malden	Sigma Phi Epsilon.
Crooks, Clarence Arthur	North Brookfield	Alpha Gamma Rho.
Cummings, Maurice Andrew	Cambridge	Theta Chi.
Davison, Ruth Eugenia	West Springfield	Abigail Adams House.
Difley, Raymond Frederick	Worcester	51 Amity Street.
Dole, William Levi	Medford	Kappa Sigma.
Estes, Wendall Eames	West Duxbury	Care of Mr. Everson.
Evans, Joseph Andrew	Lawrence	13 North College.
Farwell, Theodore Austin	Turners Falls	Alpha Sigma Phi.
Flemings, Frederic James	Sharon	Theta Chi.
Foley, Richard Carol	Portland, Me.	Sigma Phi Epsilon.
Fuller, George Leonard	Haydenville	North Amherst.
Galanie, Demetrius Lincoln	Natick	Alpha Sigma Phi.
Goldberg, Louis Noah	Wilmington	15 South College.
Goller, Hilda Margaret	Holyoke	Abigail Adams House.
Goodell, Ruth Edna	Westborough	Abigail Adams House.
Greenaway, James Emerson	Springfield	Lambda Chi Alpha.
Griffin, Raymond George	Southwick	Sigma Phi Epsilon.
Haertl, Edwin Jacob	Dorchester	Kappa Sigma.
Hanson, Daniel Cameron	Dracut	21 Fearing Street.
Harris, Herbert Joseph	Springfield	Apiary, M. A. C.
Hart, Ralph Norwood	Dorchester	Alpha Gamma Rho.
Haskins, Ralph Warner	Greenfield	Q. T. V.
Hatch, George Franklin, Jr.	West Roxbury	22 Sunset Ave.
Henneberry, Thomas Vincent	Manchester	4 North College.
Hilyard, Joseph Rayman	Beverly	Q. T. V.

[1] Candidate for degree of bachelor of vocational agriculture.
[2] Admitted on probation, entrance record incomplete.

Horner, David James	West Pelham	29½ Lincoln Ave.
Huber, Richard Alden	East Northfield	97 Pleasant Street.
Huthsteiner, Elladora Kathryn	Pittsfield	Abigail Adams House.
Johnson, Gustaf Arthur	Amherst	Theta Chi.
Joyce, Milton Goff	Rumford, R. I.	44 Triangle Street.
Kelton, Richard Coolidge	Hubbardston	13 North College.
Krassovsky, Leonid Alexander	Russia	Kappa Gamma Phi.
Kuzmeski, John William	Leverett	Leverett.
Leland, Ralph Chester	East Bridgewater	40 Sunset Avenue.
LeNoir, Thomas Benjamin [1]	Greenwood	Alpha Sigma Phi.
Loud, Emery Shaw	Rockland	Theta Chi.
Lyman, Orlando Hammond	Hilo, Hawaii	83 Pleasant Street.
Malley, Joseph Anthony	Watertown	Stockbridge Hall.
Manter, Nelson Laird	Clinton	Lambda Chi Alpha.
Maxwell, Lewis Joseph	Stoneham	West Experiment Station.
McAllister, Robert Wright	North Billerica	21 Fearing Street.
McCabe, Edith Mary	Holyoke	Abigail Adams House.
McVey, Ernest Gregory	Dorchester	Care of Mr. Everson.
Merlini, Angelo Albert	North Adams	Sigma Phi Epsilon.
Merrill, Winslow Eaton	Wilmington	81 Pleasant Street.
Milligan, Kenneth William	State Line	Lambda Chi Alpha.
Morrill, Alfred Clayton	Natick	Phi Sigma Kappa.
Mullen, Francis Redding	Becket	Sigma Phi Epsilon.
Murdough, Edwin Lincoln	Springfield	Lambda Chi Alpha.
Nash, Norman Blake	Abington	11 South College.
Nottebaert, Harry Charles	Lexington	Lambda Chi Alpha.
Parkin, William Hildreth	Chicopee	Kappa Epsilon.
Parsons, Clarence Howard	North Amherst	North Amherst.
Parsons, Josiah Waite, Jr.	Northampton	Kappa Sigma.
Partenheimer, Merrill Henry	Greenfield	Phi Sigma Kappa.
Patton, William King	Holyoke	12 North College.
Pickens, Herman Eames	Stoneham	East Experiment Station.
Powell, Charles Mason	Brookfield	Theta Chi.
Pratt, Martha Elizabeth	Hadley	Hadley.
Pyle, Everett John	Plymouth	Theta Chi.
Reed, James Burbank	Waltham	Theta Chi.
Rhoades, Lawrence Duncan	New Marlborough	West Experiment Station.
Richter, Otto Hermann	Holyoke	Alpha Sigma Phi.
Rivnay, Ezekiel	Holyoke	56 Pleasant Street.
Robinson, Neil Cooley	Arlington	8 North College.
Russell, Charles Edwin	Dodge	30 Fearing Street.
Savage, Donald Clifford	West Medford	13 Phillips Street.
Sharp, Dallas Lore, Jr.	Hingham	Care of Mr. Everson.
Snyder, Allen	Holyoke	12 North College.
Spelman, Albert Francis	New London, Conn.	Q. T. V.
Swan, Frederick Walter	Milton	Q. T. V.
Sweetland, Augustus Francis	Stoneham	Q. T. V.
Thompson, Arthur Richard	West Bridgewater	Lambda Chi Alpha.
Tobey, Edwin Albert	Belmont	Phi Sigma Kappa.
VanHall, Walter Bernhardt	Roslindale	3 North College.
Verity, Herbert Foster	Woburn	Q. T. V.
Walker, Almeda Marion	Southbridge	Abigail Adams House.
Whitaker, Lewis Harlow	Hadley	Kappa Sigma.
White, John Everett	Abington	Kappa Sigma.
Wiggin, Jennie May	Worcester	Abigail Adams House.
Williams, Earl Fletcher	Whitinsville	Kappa Epsilon.
Wilson, James Stewart	Brooklyn, N. Y.	84 Pleasant Street.
Worssam, Horace Herbert	Bernardston	Q. T. V.
Yarwood, George Arthur	Syracuse, N. Y.	101 Butterfield Terrace.

Class of 1928.

Abrahamson, Howard Joseph	Waltham	16 South College.
Agambar, Arnold William	Holyoke	81 Pleasant Street.
Amatt, Jack	Northampton	716 Bridge Street, Northampton.
Barber, Ruth Moulton	Monson	Abigail Adams House.
Barnard, Ellsworth	Shelburne Falls	17 Fearing Street.
Bartlett, Kenneth Alden	Dorchester	83 Pleasant Street.
Baumgartner, Hans	Pittsfield	29 East Pleasant Street.
Bearse, Gordon Everett	Medfield	1 North College.
Beeman, Marjorie Elise	Ware	Abigail Adams House.
Blomquist, Gustave Stanley	Quincy	83 Pleasant Street.
Bradford, David Carlton	Springfield	30 North Prospect Street.
Bray, Walter Abner	Amherst	5 Hitchcock Street.
Brockway, Horace Taylor, Jr.	South Hadley	9 South College.
Browne, Carroll Behan	Holyoke	30 Fearing Street.
Bryant, Thomas Marble	Wollaston	83 Pleasant Street.
Campbell, Donald Hays	Shirley	12 South College.
Campion, Thomas Joseph	Amherst	83 Pleasant Street.
Capone, Mario	Chelsea	29 Lincoln Avenue.
Carlson, Julius Anselm	North Abington	53 Lincoln Avenue.
Carter, Warner Harris	Amherst	R. F. D., Amherst.
Chadwick, John Shore	Worcester	27 Fearing Street.
Chapin, Horace Ralph	Chicopee Falls	60 Pleasant Street.

[1] Admitted on probation, entrance record incomplete.

Chapman, Dorothy Ann	Newtonville	Abigail Adams House.
Charleston, George Robinson [1]	Everett	101 Pleasant Street.
Clapp, Nathaniel	Greenfield	70 Lincoln Avenue.
Clark, Harold Eugene	Montague	97 Pleasant Street.
Cleary, Mary	Ayer	Abigail Adams House.
Coe, Edith Beatrice Cecilia [1]	Holyoke	Abigail Adams House.
Cook, Albert Cairnes	Waverley	9 North College.
Crowley, Francis Jeremiah	Amherst	20 Woodside Avenue.
Cunningham, James Hugh	Atlantic	11 South College.
Daniels, David Watson, Jr.	Sherborn	10 North College.
Davis, Richard Jackson	Arlington	9 Fearing Street.
Dean, Carolyn	Utica, N. Y.	Abigail Adams House.
Delaney, John	Holyoke	10 Nutting Avenue.
Denton, Ian Oliphant	Norton	33 Pleasant Street.
Devine, John Warren	Arlington	21 Fearing Street.
Draper, William Hill, Jr.	Watertown	86 Pleasant Street.
Dresser, Horatio Malcolm	South Hadley	5 Mt. Pleasant.
Duffield, Susan Muir	Detroit, Mich.	Abigail Adams House.
Eager, Vincent Shattuck	Berlin	3 Fearing Street.
Elder, Hubert Gray	Amherst	39 Amity Street.
Elliott, Lawrence William	Waltham	16 South College.
Ewer, Seth Judson	Leyden	13 Phillips Street.
Fell, Ernest Millward	Fall River	27 Fearing Street.
Ferguson, Thomas Wells, Jr.	Stow	M. A. C. Farmhouse.
Ford, John Francis	Lenox	7 Phillips Street.
Forest, Joseph Henry	Arlington	21 Fearing Street.
Fox, Pincus	Holyoke	233 Walnut Street, Holyoke.
Fox, Robert Leo	Ware	16 Nutting Avenue.
Frame, Charles Frederick	Rockland	53 Lincoln Avenue.
Frese, Paul Frederick	Waltham	7 McClellan Street.
Frost, Charles Austin	Belmont	15 North College.
Fuller, Francis Edward	Framingham	Care of Mr. Everson.
Galvin, John James	Conway	30 North Prospect Street.
Galvin, William Frederick [1]	Greenfield	14 North College.
Gifford, Charles Edwin [2]	Sutton	6 Nutting Avenue.
Goldberg, Maxwell Henry	Stoneham	15 South College.
Golden, Walter James	Brookfield	70 Lincoln Avenue.
Goldich, Louis	Philadelphia, Pa.	13 South College.
Golledge, Robert James	Cheshire	7 McClellan Street.
Gwynn, Arthur William	Roslindale	3 Nutting Avenue.
Haigis, Frederick Earl	Turners Falls	75 Pleasant Street.
Hall, Barbara Janet	Great Barrington	Abigail Adams House.
Hall, John Stanley	Lynn	17 Phillips Street.
Hamilton, Thomas Arnold	Fair Haven, Vt.	16 North College.
Harrington, Mary Eileen	Holyoke	Abigail Adams House.
Harris, Edmund George	Baldwinsville	Kappa Gamma Phi.
Hemenway, Truth Mary	Holden	Abigail Adams House.
Hintze, Roger Thomas	Amherst	13 North Prospect Street.
Hodson, Alexander Carlton	Reading	7 Phillips Street.
Holland, Bertram Holbrook	Millis	18 Nutting Avenue.
Homeyer, Frank Fuller	Wellesley Farms	84 Pleasant Street.
Howe, Frank Irving, Jr.	Norfolk	10 Nutting Avenue.
Howland, Walter Morton	Conway	44 Sunset Avenue.
Hynd, James Pratt	Holyoke	6 Gilman Street, Holyoke.
Hynes, Ralph William	Holyoke	81 Pleasant Street.
Isham, Paul Dwight	Hampden	15 Fearing Street.
Kane, Thomas Joseph	Westfield	8 Allen Street.
Karrer, Robert Joseph	Hingham	17 Phillips Street.
Kennedy, Wellington Waterloo, 3d	Red Bank, N. J.	8 North College.
Kidder, Dana Judson, Jr.	Fayville	6 Nutting Avenue.
Kimball, John Adams	Littleton	42 McClellan Street.
Knox, Barbara Howard	Taunton	Abigail Adams House.
Lane, Donald Ricker	Brockton	7 North College.
Lapean, Gerald John	Montague City	75 Pleasant Street.
LaPrise, Albert Joseph	Great Barrington	84 Pleasant Street.
Lassiter, Elizabeth Ruth [1]	Holyoke	Abigail Adams House.
Laubenstein, Karl George	Maynard	8 North College.
Lawrence, Julia Ruth	Springfield	Abigail Adams House.
Leonard, Charles Smith	Chicopee	53 Lincoln Avenue.
Leonard, Dorothy Luella	West Springfield	Abigail Adams House.
Lincoln, Robert Alexander	Hingham	53 Lincoln Avenue.
Little, Margaret Adams	Newburyport	Abigail Adams House.
Loring, Douglas Winthrop	Springfield	6 Nutting Avenue.
Madden, Thomas Raymond	Natick	97 Pleasant Street.
Mahoney, John Joseph	Westfield	8 Allen Street.
Marston, Leon Chester, Jr. [1]	Brockton	27 Fearing Street.
Martino, Dominico	Everett	29 Lincoln Avenue.
Marx, Walter Herman	Holyoke	9 South College.
McCloskey, Francis Frederick	Winchester, N. H.	Care of R. C. Adams.
McEwen, Leslie Irving	Winchester	44 Triangle Street.
McGuire, Walter Kenneth	Whitinsville	35 East Pleasant Street.
Moore, Ethan Dana	West Springfield	30 North Prospect Street.
Morey, Elizabeth Alma	Wollaston	Abigail Adams House.

[1] Admitted on probation, entrance record incomplete.
[2] Candidate for degree of bachelor of vocational agriculture.

Moriarty, Robert Earl	Monson	21 Fearing Street.
Morland, Harold Laurud [1]	Islington	66 Pleasant Street.
Mousley, Louis Brooks	Lafayette, Ind.	3 McClellan Street.
Mulhern, Daniel Joseph	Roslindale	6 North College.
Murch, Ralph Gordon	Holliston	5 North College.
Murray, Chester Leroy	Greenfield	51 Amity Street.
Noble, Frank Freeman [1]	Fall River	3 Allen Street.
Nutting, John Lyman	West Berlin	3 Fearing Street.
O'Connell, Charles Francis	Cambridge	86 Pleasant Street.
O'Connor, Margaret Merrill	Haverhill	Abigail Adams House.
Olson, Edith Anita Hildegarde	Holden	Abigail Adams House.
Owers, Robert Hammond	Taunton	18 Cottage Street.
Paige, Herman Alfred	Dorchester	Mt. Pleasant.
Panzica, Josephine	Boston	Abigail Adams House.
Perkins, Edwin Harriman	Georgetown	15 Phillips Street.
Pickard, Ashley Houghton	Littleton	42 McClellan Street.
Pickett, Thomas Austin	Beverly	3 Nutting Avenue.
Pincombe, Caroline Louise	North Adams	Abigail Adams House.
Plantinga, Oliver Samuel	Amherst	R. F. D. 3, Box 18.
Plantinga, Sarah Theodora	Amherst	R. F. D. 3, Box 18.
Poppie, Harold Sidney	Northampton	16 North College.
Pratt, Marjorie Johnson	Dalton	Abigail Adams House.
Prentiss, Adelaide Hathaway	Plainfield, Conn.	Abigail Adams House.
Preston, Charles Putnam	Danvers	83 Pleasant Street.
Preston, Stanley Nichols	Danvers	83 Pleasant Street.
Proctor, Harriet Ellise	South Weymouth	Abigail Adams House.
Purrington, Rachel Elizabeth	Shattuckville	Abigail Adams House.
Quinn, John Francis	New Bedford	50 Northampton Road.
Redgrave, Arnold Ide	Hopedale	83 Pleasant Street.
Reed, Roland Ellsworth	Greenfield	14 North College.
Reynolds, John, Jr. [1]	Hatchville	69 Lincoln Avenue.
Rice, Cecil Curtis	Worcester	30 Fearing Street.
Richardson, Alden Lafayette	Groveland	Care of Prof. Banta, Sunset Avenue.
Richardson, Evan Carleton	Millis	18 Nutting Avenue.
Ricker, Albion Barker	Turner, Maine	5 North College.
Rodimon, Warner Scott	Florence	15 North College.
Roper, Hartwell Eveleth	Closter, N. J.	M. A. C. Farmhouse.
Rouillard, Henley Granville [1]	East Longmeadow	20 North Prospect Street.
Rourke, Charles Henry	Framingham	8 Kellogg Avenue.
Ryan, Edward Parker [1]	Swampscott	6 Nutting Avenue.
Saunders, Francis William	Keene, N. H.	Kappa Sigma.
Schappelle, Newell Allen	Amherst	25 Amity Street.
Schmidt, Ernest John	Longmeadow	6 Nutting Avenue.
Simmons, Oliver Dorrance	Beverly	84 Pleasant Street.
Slate, Robert Irving	Bernardston	10 North College.
Smith, Bessie May	Somerville	Abigail Adams House.
Smith, Charles James, Jr.	North Wilmington	15 Phillips Street.
Smith, Eliey Herbert	West Springfield	20 North Prospect Street.
Smith, Leslie Rockwell, Jr.	Hadley	Hadley.
Smith, Walter Russell	Holden	18 Cottage Street.
Southgate, Barbara Willson	Boston	Abigail Adams House.
Spencer, Ernest Leavitt	Lowell	83 Pleasant Street.
Stowell, Walter Henry	Grafton, Vt.	The Aggie Inn.
Stratton, Frank	Lawrence	86 Pleasant Street.
Thomas, Howard [2]	Holyoke	6 Beacon Avenue, Holyoke.
Thompson, Frances Clarinda	Amherst	Mt. Pleasant.
Thompson, Leonard Louis	Greenfield	14 North College.
Trull, Henry Bailey	Lowell	84 Pleasant Street.
Tufts, Warren John	Jamaica Plain	1 North College.
Tulloch, George Sherloch	Bridgewater	Q. T. V.
Tuttle, Alden Parker	South Milford	Baker Place.
Vaughan, Herbert Sidney	Attleboro	6 Nutting Avenue.
Vetterstrand, Marguerite	Northampton	Abigail Adams House.
Voetsch, George Bernard	Greenfield	70 Lincoln Avenue.
Warfield, Eleanor Thayer	Worcester	Abigail Adams House.
Washburn, Edward Allen [2]	Marion	86 Pleasant Street.
Weaver, Edward Leigh [1]	Amherst	Pine Street.
Welch, Richard Francis	Salem	4 Nutting Avenue.
Wendell, George Goodwin	Belmont	9 North College.
Whitcomb, Oliver Adams	Littleton	42 McClellan Street.
White, Edwin Searles	Worcester	9 Fearing Street.
Wilcox, Philip Emerson [2]	Rockland	15 Fearing Street.
Wilder, Edwin Arthur	Sterling	83 Pleasant Street.
Williams, Florence Dorothea	East Norton	Abigail Adams House.
Williams, Lloyd George	Pittsfield	17 Phillips Street.
Wilson, George Stewart	Framingham	81 Pleasant Street.
Yarrows, Joseph John	Hatfield	Hatfield.
Young, Edward Henry	Northampton	53 Lincoln Avenue.
Zielinski, Carl Bernard [2]	Holyoke	3 Fearing Street.

[1] Candidate for degree of bachelor of vocational agriculture.
[2] Admitted on probation, entrance record incomplete.

Registered after the Catalogue for 1923 was published.

Class of 1927.

Waite, Clifton Brooks	Orange.

Special Students.

Binner, Theresa Marie	Amherst.
Cadogan, Kathryn	Wakefield.
Larrabee, Edward Noble	West Roxbury.

Special Students.

Allen, Leo Linwood Fenton	Orange	4 Nutting Avenue.
Baucus, Harriet Flood	Northampton.	Northampton
Burnett, Marston	Cambridge	Wilder Hall.
Coveney, John Joseph	Amherst	R. F. D. 3, Box 82.
Delaney, Rose Margaret	Holyoke	Draper Hall.
Gilbert, Marguerite Frances	Amherst	Meadow Street.
Globus, Joseph	Attleboro	Poultry Plant.
Johnson, Catherine Genevieve	Amherst	West Street.
Jones, Pearl	Troy, Ala.	Abigail Adams House.
Matson, Anna Nathalie	Pasadena, Calif.	Abigail Adams House.
Norrie, Lawrence Edward	Springfield	9 Fearing Street.
Patterson, Jane	Amherst	26 Lincoln Avenue.
Perley, Sadie	Boston	Abigail Adams House.
Pierpont, Mildred	Amherst	28 Pleasant Street.
Pushee, George Frederick	Amherst	North Amherst.
Reid, Howard Stanton	Franklin	18 Cottage Street.
Shepard, Eleanor Chalmers	Pepperell	120 Pleasant Street.
Thayer, Charles Hiram	Amherst	South East Street.
Thompson, Alice Elizabeth	Amherst	Mt. Pleasant.
Waugh, Sidney Biehler	Amherst	M. A. C.

Geographical Summary.

Massachusetts	520	Maryland	1
Connecticut	7	Missouri	1
New York	5	South Dakota	1
Rhode Island	4	Washington	1
Maine	3	West Virginia	1
Michigan	3	Wisconsin	1
New Jersey	3	Utah	1
Vermont	3	Asia Minor	1
Florida	2	Canada	1
New Hampshire	2	Hawaii	1
Pennsylvania	2	Russia	1
South Carolina	2	Trinidad	1
Alabama	1		
California	1	Total	571
Indiana	1		

Summary by Classes.

Class.	Men.	Women.	Total.
Graduate School	53	8	61
Seniors, 1925	79	4	83
Juniors, 1926	99	14	113
Sophomores, 1927	100	10	110
Freshmen, 1928	153	31	184
Specials	9	11	20
Totals	493	78	571

Short Course Enrollment.

Two-Year Graduates, 1924.

Aldrich, James Orin	Belchertown.
Austin, Eunice Marie	Fall River.
Beley, Robert Arsene	Newtonville.
Bisbee, John Carroll, Jr.	Moretown, Vt.
Blanchard, Lawrence Newell	Leominster.
Booth, George Wellesley	Everett.
Brown, Herbert Ellsworth	Shrewsbury.
Bryant, Berton Davis	Lowell.
Carter, William Bradley	Tewksbury.
Chisholm, Roy Bedford	Dorchester.
Clarkson, Arnold	Reading.
Cole, Albert Bradley	Millbrook, N. Y.
Conklin, Lester Martin	Patchogue, N. Y.
Craig, Kenneth	Boston.
Cromack, Elwin Baldwin	Colrain.
Cutler, Samuel Austin	Boylston.
Darling, Walter	Franklin.
Dennen, Charles Otis	East Pepperell.
Dennison, Leon Henry	Atlantic.
Densmore, Theodore Calder	Natick.
Eastwood, Wilfred	North Adams.
Emery, Russell Louis	Needham.
Files, Arthur Dysart	Wilbraham.
Fitts, Harry Bucklin	Orange.
Fortune, Battie Holmes	Boston.
Glencross, John Donald	Canada.
Goode, Frank Arthur	Boston.
Goodnow, Alice Marguerite	Athol.
Haffermehl, Forrest Wendell	Newton Center.
Harris, George Mitchell	Lynn.
Hawthorne, Peter, Jr.	Amherst.
Haynes, Joseph Haynes	Keene, N. H.
Hazard, James Joseph	Westwood.
Hazen, Stanley Luther	Longmeadow.
Healey, Martin Joseph	Lynn.
Higgins, Leonard Martin	Fall River.
Howe, Wesley Mason	Millbury.
Hulbert, Jewett William	Dorchester.
Jones, Charles	Waitsfield, Vt.
Jones, Wendell Albert	Roslindale.
Joslin, Ralph Herbert	Waitsfield, Vt.
Lauterbach, Louis Jacob	Roslindale.
Longley, Lawrence Stanley	Greene, Me.
Lowe, Dwight Mansfield	Watertown.
MacFadyen, Alfred Wellington	Wellesley.
Macuen, Harvey Andrew	Newton.
Martyn, Roland Fowler	West Suffield, Conn.
Miller, Everett Woodman	Fairhaven.
O'Doherty, John Edward	Woburn.
Olsen, Harold Bailey	Pepperell.
Paddock, Franklin Selby	Worcester.
Palmer, Albert Tresnon	Everett.
Parsons, Sidney Wing	Conway.
Peaslee, George Raymond	Pittsfield.
Peklaris, Spiros Antony	Lowell.
Sahlin, Carl Evert	Somerville.
Scotland, Gordon Lionel	Saxonville.
Solomon, Maurice	Melrose.
Springer, Harry Brooke	Hartland, Vt.
Stevens, Glenn William	Waverley.
Stover, Walter Edward	Wellesley.
Tobin, Michael Francis	Adams.
Tucker, Clarence Murray	Waitsfield, Vt.
Turffs, Clarence Joseph	Worcester.
Walker, Franklin Perry	Westborough.
Webster, Phyllis	Cambridge.
White, Laurence Schaffner	Dover.
White, Newell Dudley	Bristol, Conn.

Second Year Two-Year Students, 1924–25.

Ackerman, Randolph Spofford	Salisbury	Sunset Avenue, care of Mr. Banta.
Ansell, Harold King	Grantwood, N. J.	3 McClellan Street.
Arnold, Elliott Frank	Woburn	Kolony Klub.

Baker, Willis A.	Boston	Kolony Klub.
Berry, Harold Edward	Natick	Kolony Klub.
Breckenridge, Earl	Andover	Fearing Street, care of Mrs. Nims.
Buswell, Albert Henry	Belmont	Kolony Klub.
Caless, Thomas Winfred	Westford	25 Gray Street.
Cepurneek, Andrew John	Wrentham	A. T. G. North College.
Chilson, Dorothy Lila	Huntington	Abigail Adams House.
Cooper, Janice Marie	Westfield	Abigail Adams House.
Crooks, Donald Lovell	North Brookfield	15 Hallock Street.
Crooks, Harold Baker	North Brookfield	15 Hallock Street.
Cummings, Frank James	North Adams	17 Phillips Street.
Dennett, James Winslow	Plympton	A. T. G. North College.
Derby, Benjamin Edward	Concord Junction	60 Pleasant Street.
Devine, Theodore Joseph	Taunton	3 Allen Street.
Frawley, Earl Alton	New Bedford	Kolony Klub.
Friedli, George Edward	Yonkers, N. Y.	A. T. G. North College.
Frieh, George Joseph	Boston	60 Pleasant Street.
Fuller, Douglas William	Southampton, N. Y.	108 Pleasant Street.
Griswold, Christine Mueller	Springfield	Abigail Adams House.
Hall, Ivory Arthur	South Portland, Me.	3 Nutting Avenue.
Harrington, Donald Francis	Framingham	A. T. G. North College.
Harrington, Douglas Waldomar	Framingham	A. T. G. North College.
Hartney, Clyde Clarence	Athol	A. T. G. North College.
Hayn, Ernest Morris	Springfield	108 Pleasant Street.
Hines, Oliver Clayton	Amherst	Amherst House.
Hoyle, William	Northborough	71 Main Street.
Jordan, William D.	Somerville	97 Pleasant Street.
Kane, John Vincent	Lenox	Kolony Klub.
Keyes, Madelon Frances	Dorchester	Abigail Adams House.
Kingsbury, Carl Manning	Woodville	Sunset Avenue, care of Mr. Banta.
Kyle, Gordon	Everett	The Davenport.
Lacombe, Albert George	Beverly	– –
Lahey, Jeremiah Joseph	Plymouth	97 Pleasant Street.
Lawton, Clarence Copeland	Worcester	3 McClellan Street.
Lindgren, Lawrence Edward	Amherst	60 Pleasant Street.
Matuleurcz, Andrew Joseph	Orange	60 Pleasant Street.
Mecum, Ethel Doris	Becket	Abigail Adams House.
Mellor, John Albert	Somerville	13 Phillips Street.
Merryman, Rebecca Eastman	Bradford	Abigail Adams House.
Montague, Guilford	South Deerfield	97 Pleasant Street.
Morrissey, John Francis	Brooklyn, N. Y.	97 Pleasant Street.
Murphy, Thomas Patrick	Woburn	Kolony Klub.
Myers, Morley Whitfield	Hingham	Kolony Klub.
McGregor, Janet	Haverhill	Abigail Adams House.
Nutter, Richard Louis	Melrose Highlands	20 Spring Street.
O'Hara, Francis Edward	Worcester	3 McClellan Street.
Patch, Frederic Whiting	Framingham	A. T. G. North College.
Patterson, Harold Taylor	Barre	75 Pleasant Street.
Payne, Donald Tubbs	Dunstable	116 Pleasant Street.
Perkins, Harold Kent	Melrose Highlands	5 Hitchcock Street.
Pickard, Cyrus Warren	Concord Junction	A. T. G. North College.
Pomeroy, Allen Bradford	Longmeadow	Kolony Klub.
Power, James Anthony	Arlington	Kolony Klub.
Ross, Edward Cooper	Watertown	Fearing Street, care of Mrs. Nims.
Scott, Thomas John	Bristol, Conn.	108 Pleasant Street.
Severance, Charles Almon	Moultonboro, N. H.	Kolony Klub.
Stow, Basil Tenney	Stow	R. F. D. No. 3, Amherst.
Thompson, Kenneth Horatio	Revere	45 Pleasant Street.
Titus, Alvin Randolph	Allston	17 Phillips Street.
Tower, Lester Wilton	South Weymouth	M. A. C. Farm.
Towne, Milton Curtis	Petersham	60 Pleasant Street.
Welch, John D.	Northfield, Vt.	75 Pleasant Street.
Woodruff, Webster Clinton	Fitchburg	30 Fearing Street.
Wright, Harriett Goodhue	Boston	Abigail Adams House.

First Year Two-Year Students, 1924–25.

Adams, Charles	Rutland	165 South Pleasant Street.
Alcott, Elverton Hunting	Newton	Mt. Pleasant, care of Professor Sears.
Ames, Bessie Bell	Marshfield Center	Abigail Adams House.
Anderson, Frederic	Grafton	81 Pleasant Street.
Apelquist, Philip Eugene	Orange	Pine Street.
Banks, Harold Bryant	Holliston	35 East Pleasant Street.
Bassett, Sherrold Emerton	Everett	17 Phillips Street.
Belcher, Ranald Ashley	North Abington	35 East Pleasant Street.
Blood, Charles Andrew Fletcher	Pepperell	116 Pleasant Street.
Bradley, Howard Courtland	Seekonk	9 Fearing Street.
Brown, Charles Franklin	Worcester	116 Pleasant Street.
Brown, Earl	Amherst	Pelham Road.
Bumstead, Augustine	Medford	35 East Pleasant Street.
Burgevin, Paul Louis	Port Chester, N. Y.	75 Pleasant Street.
Callander, Murray Austin	Boston	55 Amity Street.
Carl, Sidney	Hatfield	83 Pleasant Street.
Carrington, Harvie Brigham	Huntington	27 East Pleasant Street.

Clark, Stewart Floyd	Conway	Mt. Pleasant, care of Mr. C. R. Green.
Cogswell, Sarah Ellen	Westborough	Abigail Adams House.
Comeau, Charles Edward	Concord Junction	60 Pleasant Street.
Cree, Stephen Comey	Leicester	4 Hallock Street.
Crocker, Ralph Herman	Holliston	6 Nutting Avenue.
Davidson, Henry Wilbur	Auburn	116 Pleasant Street.
Davis, Charles Ellsworth	North Adams	23 East Pleasant Street.
Davis, William Hazen	Ward Hill	29 North Prospect Street.
DeLano, Fred Lewis	Richmond Hill, N. Y.	29 North Prospect Street.
DeLorenzo, Joseph	Kingston	35 East Pleasant Street.
Desrosiers, Adolphe Biron	Orange	Pine Street.
Dillon, Frank Edward	New Bedford	Baker Lane.
Dingley, Elmer Albian	Sherborn	3 Fearing Street.
Donnelly, Edward Boyce	Waltham	21 Pleasant Street.
Forgie, James Brice	Boston	6 Nutting Avenue.
Foster, William Edward	Ipswich	South College.
Fullam, Kenneth Bullord	North Brookfield	15 Hallock Street.
Goldthwaite, Ernest	Dunstable	17 Phillips Street.
Granger, Edward Whitney	Huntington	South Amherst, care of J. W. Tufts.
Hawes, Ralph Edmund	Sudbury	97 Pleasant Street.
Hayden, Charles Ernest	Newtonville	35 East Pleasant Street.
Hayden, Robert Evans	Brookville	97 Pleasant Street.
Herron, Frank Robert	Greenfield	The Davenport.
Hess, Frank Wesley	Springfield	84 Pleasant Street.
Holden, Clayton Lewis	Bondsville	68 Lincoln Avenue.
Hoxie, Edward Graham	Dalton	18 Cottage Street.
Humphrey, Leo Harris	Medford	North Pleasant Street, care of R. C. Adams.
Hyde, Gerald	Buzzards Bay	116 Pleasant Street.
Jansen, Wesley Leonard	Amherst	18 East Street.
Johnson, Gunnar Theodore	Leicester	31 North Prospect Street.
Johnson, Tage Frederick	Milton	6 Nutting Avenue.
Kaakinen, Theodore	Fitchburg	17 Phillips Street.
Ladd, Joseph Mark	Worcester, Vt.	44 Pleasant Street.
Leoncini, Louis John	Milford	83 Pleasant Street.
Markert, Ernest Frederick	Amherst	West Street.
Massa, Andrew Louis	East Boston	35 East Pleasant Street.
Mathews, George Williams, Jr.	Dedham	116 Pleasant Street.
Meeker, Alice Maude	Ludlow	Abigail Adams House.
Mellen, James Dwight	Athol	29 East Pleasant Street.
Menchin, Elinor Louise	North Weymouth	Abigail Adams House.
Miller, Edward Doring	Lee	81 Pleasant Street.
Morey, Alfred William	Cummington	South Amherst, care of A. B. Richards.
MacCulloch, William Webster	Salem	17 Phillips Street.
Maclean, Theodore Elwin	Hadley	84 Pleasant Street.
McCurdy, John	Gardiner, Maine	41 Pleasant Street.
Nash, Alexander Allaire	Mattapoisett	6 Nutting Avenue.
Newhall, Benjamin Weston	Danvers	84 Pleasant Street.
Palmer, Charles Stephen	Weymouth	45 Pleasant Street.
Parsons, Harold Kenneth	Brooklyn, N. Y.	24 McClellan Street.
Parsons, Philip Hinde	Manchester	4 Hallock Street.
Pearse, William Thomas	Rockland	101 Pleasant Street.
Porr, John L.	Bronx, N. Y.	Box 125, M.A.C.
Potter, Charles Elliott	Hyde Park	35 East Pleasant Street.
Prouty, Homer Spooner	Hardwick	23 East Pleasant Street.
Putnam, Frank Wendell	West Newton	66 Pleasant Street.
Richards, Foster Herbert	Lowell	1 Cottage Street.
Riley, Ernest Francis	Dedham	31 North Prospect Street.
Root, Worth Stewart	Colrain	97 Pleasant Street.
Rowell, Elisabeth Johnson	Groton	Abigail Adams House.
Ryan, Roger Wolcot	Pepperell	60 Pleasant Street.
Safran, Mayer	Manchester, N. H.	56 Pleasant Street.
Sawyer, Roland Willard	Groton	R. F. D. No. 3, North Amherst.
Shelnut, Charles Francis	South Boston	4 Hallock Street.
Smith, Edith Caswell	Wakefield	Abigail Adams House.
Snyder, Frederic Burley	Wakefield	Mt. Pleasant, care of Mr. C. R. Green.
Steele, Putnam	Milton	66 Pleasant Street.
Strong, Arthur Eugene	Amherst	13 Hallock Street.
Sullivan, Maurice Laurence	Peabody	45 Pleasant Street.
Tonseth, Richard	Lunenburg	4 Hallock Street.
Tribe, Stanley Gordon	West Somerville	55 Amity Street.
Truelson, Stanley Dunham	Somerville	3 Nutting Avenue.
Varnum, William Parker	Collinsville	1 Cottage Street.
Walker, Roger Francis	South Sudbury	97 Pleasant Street.
Wheadon, Willard Spencer	Chelsea	29 Lincoln Avenue.
Whitcomb, Janet	Haverhill	Abigail Adams House.
Wood, Helen May	Stoughton	Abigail Adams House.
Yocum, Margaret Gardner	Irvington, N. J.	Abigail Adams House.

Special Two-Year Students, 1924–25.

Caless, Mrs. Sybell	Westford	25 Gray Street.
Thayer, Richard	Somerville	Kolony Klub.

Winter School, 1924.

Ames, John A.	Piermont, N. H.
Anglim, Henry T., Jr.	Brockton.
Baudin, Elias	Springfield.
Beiser, Herbert K.	North Caldwell, N. J.
Bergstrom, Eric H.	Lynn.
Blascah, John	Springfield.
Brickman, Anna	Great Barrington.
Buckshorn, Fisher	Westford.
Chadwick, F. E.	Woodsville, N. H.
Cooney, John J.	Lowell.
Davis, Horace	Rochester.
Dehner, Cecil	Burlington, Iowa.
Doescher, Fred	Houlton, Me.
Doescher, Mrs. Fred	Houlton, Me.
Donaldson, Fred A.	Greenfield.
Drain, Mrs. Brooks D.	Amherst.
Duno, Harold	Lowell.
Dunsmoor, Ethelbert W.	Hampden.
Fair, James E.	Framingham.
Fillmore, William L.	Amherst, N. S.
Flavin, Edmund J.	Malden.
Fogg, Sarah B.	Greensburg, Pa.
Gardner, George E.	Somerville.
Gaston, N. E.	Concord.
Gaunt, Frank L.	Springfield.
Geiger, Mary E.	Pepperell.
Goldthwaite, Roger G.	Dunstable.
Greenwood, Burton H.	Brooklyn, N. Y.
Groepler, Martin, Jr.	Yonkers, N. Y.
Harnett, Francis	Milton.
Hescock, Ralph W.	West Brattleboro, Vt.
Hickson, Robert C.	Shrewsbury.
Holden, Henry R.	Amherst.
Horak, Joseph A.	Lynn.
Hoyle, Walter J.	Woonsocket, R. I.
Jackson, Noble T.	Boston.
Jenks, Elsworth F.	Amherst.
Jenks, George H.	South Dartmouth.
Jones, Mrs. Martha W.	Quakertown, Pa.
Knudsen, John T.	Boston.
Larose, Ernest A.	South Hadley.
La Salle, James H.	North Hadley.
Lee, Lydia C.	Boston.
L'Esperance, Herbert C.	Cambridge.
Markert, Richard H.	Amherst.
McCann, F. J.	Clinton.
McNamara, Roger	Greenfield.
Merchant, Percy A.	Gloucester.
Monroe, Huntington T.	Framingham.
Moore, Frank C.	Keene, N. H.
O'Neil, Harry C.	Amherst.
Parker, Charles W.	East Orleans.
Parker, Mrs. Charles W.	East Orleans.
Parker, Royce M.	South Chelmsford.
Parsons, Kenneth P.	Clinton.
Prince, Carleton S.	Arlington.
Richards, Fred V.	Milton.
Richardson, Ralph S.	Brockton.
Rogers, John	Cambridge.
Rogers, William	Fairhaven.
Rossi, Orpheus J.	Medfield.
Sears, Francis H.	Charlemont.
Smith, Edgar W.	Lowell.
Smith, Herbert C.	Woodville.
Stanford, Joseph H.	Rowe.
St. Martin, Alfred	Holyoke.
Sullivan, Charles A.	Dorchester.
Tait, Raymond G.	Springfield.
Taylor, Charles	Whitman.
Tsourides, Nicholas A.	Worcester.
Turner, E. H.	Everett.
Vanderploeg, Bernice M.	Holland, Mich.
Wade, Senior	Woonsocket, R. I.
Walter, Elmer H.	Melrose.
Webb, Kenneth	Needham Heights.
Weinsel, Beatrice	Norwich, Conn.
West, Osborne	Hadley.
Wheadon, Willard	Chelsea.
Wheeler, Phillips W.	Randolph.
Wile, Ira R.	New York, N. Y.
Wilton, Charles W.	North Andover.
Yarrows, Elias	Amherst.
Zahir, Alfred	Amritsar, India.

Summer School Students, 1924.

Acheson, Lillian	Fall River, Mass.
Alley, Alice J.	Amherst, Mass.
Alvord, Alice	Easthampton, Mass.
Anderson, Leslie	East Bridgewater, Mass.
Avery, Roy C.	New York, N. Y.
Belcher, D. Webster	Hatfield, Mass.
Belyea, Beatrice M. A.	East Bridgewater, Mass.
Boland, Mary L.	Worcester, Mass.
Bolles, Audrey	Amherst, Mass.
Booth, Sarah E.	Springfield, Mass.
Brockway, Alice M.	South Hadley, Mass.
Brown, Marguerite Z.	Amherst, Mass.
Brown, Mildred E.	North Amherst, Mass.
Brown, Paul W.	Fiskdale, Mass.
Burnham, Dorothy I.	Newtonville, Mass.
Campbell, N. Merle	East Lynn, Mass.
Campion, Margaret E.	Amherst, Mass.
Canavan, Anne M.	Amherst, Mass.
Cassano, Joseph	Groveland, Mass.
Cassidy, Morton H.	Amherst, Mass.
Clark, Mabelle J.	Sunderland, Mass.
Connelly, Helen M.	Dorchester, Mass.
Cooke, Joan L.	Amherst, Mass.
Coveney, John	Amherst, Mass.
Cussell, Julia	Lawrence, Mass.
Davenport, Mrs. Pearl T.	Amherst, Mass.
Davis, Josephine E.	Holden, Mass.
Davis, Orrin C.	Belchertown, Mass.
Devine, John W.	Arlington, Mass.
Dickinson, Laura A.	North Amherst, Mass.
Dickinson, Mrs. Mary M.	Amherst, Mass.
Duffy, Leo F.	Springfield, Mass.
Durkee, Lewis L.	Beverly, Mass.
Eastwood, John E.	Plymouth, Mass.
Elder, Helen B.	Amherst, Mass.
Ely, Genevieve M.	Northampton, Mass.
Everson, Bettina L.	Amherst, Mass.
Fairty, Florence M.	New Canaan, Conn.
Fein, Louis	Springfield, Mass.
Flynn, Alan F.	Newton, Mass.
Ford, Violet C.	Holyoke, Mass.
Geiger, Eleanor C.	Pepperell, Mass.
Gibbard, James	Toronto, Ontario, Canada.
Gilbert, Chauncey M.	Amherst, Mass.
Gilbert, Mrs. Marguerite F.	Amherst, Mass.
Gledhill, Minnie L.	Amherst, Mass.
Glick, Mrs. Mabel R.	Amherst, Mass.
Gordon, Samuel F.	Ipswich, Mass.
Gregory, Helen J.	Northampton, Mass.
Griffin, Bridget	Bondsville, Mass.
Haigis, Frederick E.	Turners Falls, Mass.
Harris, Edmund G.	Baldwinville, Mass.
Hatch, Mrs. Mary A.	Holyoke, Mass.
Hays, Frank A.	Amherst, Mass.
Hemenway, Mrs. Elsie W.	Northampton, Mass.
Hemenway, Truth M.	Holden, Mass.
Holbrook, Lester M.	New Bedford, Mass.
Horner, David J.	West Pelham, Mass.
Hyde, William E.	Amherst, Mass.
Jack, Melvin C.	Amherst, Mass.
James, Marvin E.	Florence, Mass.
Jones, Janet M.	Amherst, Mass.
Kelsey, Edmund B.	Amherst, Mass.
Kenney, George S.	Amherst, Mass.
Kenney, Irene E.	Amherst, Mass.
Kingsford, Vera A.	Boston, Mass.
Kielbowicz, Nellie	Amherst, Mass.
Knightly, Mary R.	Amherst, Mass.
Kostenbader, Marie	Holyoke, Mass.
Kremensky, Susie M.	Hadley, Mass.
Lawley, Evelyn G.	Florence, Mass.
Leclair, Carmella M.	Amherst, Mass.
Leitch, Fredonna	Amherst, Mass.
Loomis, Susan B.	Lynn, Mass.
Luddington, Frank D.	Hamden, Conn.
Lyman, Elliott B.	South Hadley, Mass.
Mahoney, Walter F.	Millville, Mass.
Mansfield, Anne	Bondsville, Mass.
Mansfield, Bernard J.	Haydenville, Mass.
Mart, Willis H.	Richmond, Mass.
Martin, Frances B.	Amherst, Mass.
Martin, Margaret	Amherst, Mass.
Mayo, William I.	Northampton, Mass.
McDonnell, Anna H.	Florence, Mass.
McGrath, Grace A.	Northampton, Mass.

Medve, Elizabeth	Lawrence, Mass.
Merrill, Estella L.	North Lebanon, Maine.
Miller, Edith L.	Wakefield, Mass.
Mouradian, Garabed K.	Bridgewater, Mass.
Newlon, Mrs. J. B.	Amherst, Mass.
Nietzold, Hazel R.	Northampton, Mass.
Novitch, Sidney A.	Revere, Mass.
O'Connor, Arthur M.	Amherst, Mass.
Oetinger, Emma M.	Boston, Mass.
Page, Fay R.	Haydenville, Mass.
Parsons, Ethel E.	Northampton, Mass.
Parshley, Louise	Northfield, Mass.
Patterson, Florence	Amherst, Mass.
Phelan, John	Amherst, Mass.
Poey, Frederick	Havana, Cuba.
Powers, Marcella K.	Florence, Mass.
Prescott, Glenn C.	Florence, Mass.
Pushee, Julia L., Mrs.	North Amherst, Mass.
Reed, Mary L., Mrs.	Amherst, Mass.
Rice, Victor A.	Amherst, Mass.
Richardson, Lewis E.	Millis, Mass.
Riley, Margaret A.	Holyoke, Mass.
Roberts, Verne E.	Amherst, Mass.
Robinson, Lewis B.	Pembroke, N. H.
Rose, Christina M.	Chester, Mass.
Rose, Grace M.	Chester, Mass.
Rundquist, Edna J.	Gloucester, Mass.
Sanctuary, William C.	Amherst, Mass.
Sanborn, Mrs. L. W.	North Amherst, Mass.
Sanderson, Susie E.	Haydenville, Mass.
Sawtelle, Donald W.	Amherst, Mass.
Sawyer, Mabel A.	Watertown, Mass.
Schenker, Elsie A.	Holyoke, Mass.
Scribner, Agnes E.	Amherst, Mass.
Searle, Jean N.	Amherst, Mass.
Shaw, Doris E.	Amherst, Mass.
Shaw, Edna A.	Amherst, Mass.
Simonds, Henry E.	Winchester, Mass.
Smart, Harold W.	Amherst, Mass.
Smith, Myron N.	Millbury, Mass.
Spaulding, Marion E.	Amherst, Mass.
Spaulding, Ruth E.	Amherst, Mass.
Strickland, Elinor L.	Amherst, Mass.
Sturtevant, Ralph E.	Greenfield, Mass.
Sweetland, Augustus F.	Stoneham, Mass.
Thomas, Helen R.	Amherst, Mass.
Thompson, Alice E.	Amherst, Mass.
Thompson, Frances C.	Amherst, Mass.
Thompson, Nellie L.	Amherst, Mass.
Thornton, Clarence P.	West Pelham, Mass.
Thyng, Anne M.	Readfield, Maine.
Walsh, Elizabeth R.	Amherst, Mass.
Walsh, John L.	Amherst, Mass.
Warner, Frances A.	Amherst, Mass.
Warner, Irene C.	Amherst, Mass.
Wilder, Frank H.	Sterling, Mass.
Worssam, Horace H.	Bernardston, Mass.
Vetterstrand, Marguerite	Northampton, Mass.
Zwisler, Frederick F.	Holyoke, Mass.

Students registered after the Catalogue for 1923–24 was published.

Two-Year Course.

First year:

Eissold, Richard Hiersche	Ludlow.
Prentiss, Mrs. Bertha White	Amherst.

Vocational Poultry Course.

Cahill, John Vincent	Lowell.
Cudak, Walter	Adams.
Emerson, William Henry	East Boston.
Grew, Bernard Carlton	Bass River.

Summary of Short Course Enrollment.

	Men.	Women.	Total.
Two-year Course, second year	59	8	67
Two-year Course, first year	85	9	94
Two-year Course, special students	1	1	2
Winter School, 1924	72	11	83
Summer School, 1924	55	89	144
Totals	272	118	390

INDEX.

PUBLIC DOCUMENT No. 31

MASSACHUSETTS AGRICULTURAL COLLEGE

THIRTY-SEVENTH ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

REPORT OF THE DIRECTOR FOR THE FISCAL YEAR ENDING NOV. 30, 1924, PUBLISHED IN ACCORDANCE WITH THE PROVISIONS OF SECTION 32 OF CHAPTER 30 OF THE GENERAL LAWS

Being Parts III and IV of the Sixty-Second Annual Report of the Massachusetts Agricultural College

A Record of the Forty-Second Year from the Founding of the State Agricultural Experiment Station

DEPARTMENT OF EDUCATION
THE COMMONWEALTH OF MASSACHUSETTS

Publication of this Document approved by the Commission on Administration and Finance

2500 11-'25 Order 3370.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

Officers and Staff.

STATION STAFF.

Administration.

Sidney B. Haskell, B.Sc., *Director*.
Joseph B. Lindsey, Ph.D., *Vice-Director*.
Fred C. Kenney, *Treasurer*.
Basil B. Wood, A.B., *Librarian*.
Edwin F. Gaskill, B.Sc., *Assistant to the Director*.
Mrs. Lucia G. Church, *Secretary to the Director*.
Miss F. Ethel Felton, A.B., *Editorial Assistant*.

Agricultural Economics.

Alexander E. Cance, Ph.D., *Professor*.
Miss Lorian P. Jefferson, M.A., *Assistant Research Professor*.

Agronomy.

Arthur B. Beaumont, Ph.D., *Professor*.
John P. Jones, M.Sc., *Assistant Research Professor*.

Animal Husbandry.

—— ——, *Professor*.

Botany.

A. Vincent Osmun, M.Sc., *Professor*.
Paul J. Anderson, Ph.D., *Research Professor*.
Orton L. Clark, B.Sc., *Assistant Professor*.
William L. Doran, M.Sc., *Assistant Research Professor*.
Theodore T. Ayers, B.Sc., *Investigator*.
Miss Gladys I. Miner, *Curator*.
Miss Dorothy M. Parsons, *Stenographer*.
Alyn S. Ball, *Laboratory Assistant*.

Cranberry Station.

Henry J. Franklin, Ph.D., *Research Professor in Charge*.
Donald S. Lacroix, B.Sc., *Investigator*.

Dairying.

Henry F. Judkins, B.Sc., *Professor*.

Entomology.

Henry T. Fernald, Ph.D., *Professor*.
Arthur I. Bourne, A.B., *Assistant Research Professor*.
Harlan N. Worthley, M.Sc., *Assistant Research Professor*.
Miss E. M. Kiley, *Stenographer*.

Farm Management.

James A. Foord, M.Sc.Agr., *Professor*.

Horticultural Manufactures.

Walter W. Chenoweth, M.Sc., *Professor*.

Vegetable Gardening and Market Garden Field Station.

Victor A. Tiedjens, M.Sc., *Assistant Research Professor*.
Miss Edith E. Meehan, *Stenographer*.

Meteorology.

John E. Ostrander, A.M., C.E., *Meteorologist*.

Microbiology.	Charles E. Marshall, Ph.D., *Professor.* Chester H. Werkman, Ph.D., *Assistant Professor.*
Plant and Animal Chemistry.	Joseph B. Lindsey, Ph.D., *Chemist.* Edward B. Holland, Ph.D., *Research Professor.* Fred W. Morse, M.Sc., *Research Professor.* Carlton P. Jones, M.Sc., *Assistant Research Professor.* John G. Archibald, M.Sc., *Assistant Research Professor.* Gerald M. Gilligan, B.Sc., *Investigator.* Harry L. Allen, *Laboratory Assistant.* James R. Alcock, *Assistant in Animal Nutrition.* Miss Margaret C. Eppler, *Clerk.*
Pomology.	Fred C. Sears, M.Sc., *Professor.* Jacob K. Shaw, Ph.D., *Research Professor.* John S. Bailey, M.Sc., *Investigator.* Harold E. Wilson, *Laboratory Assistant.* Miss Ethelyn Streeter, *Stenographer.*
Poultry Husbandry.	John C. Graham, B.Sc., *Professor.* Frank A. Hays, Ph.D., *Research Professor.* Miss Ruby Sanborn, A.B., *Investigator.* Miss Katherine W. Davis, *Clerk.*
Rural Engineering.	Christian I. Gunness, B.Sc., *Professor.*
Veterinary Science and Animal Pathology.	G. Edward Gage, Ph.D., *Professor.* Norman J. Pyle, V.M.D., *Assistant Research Professor of Avian Pathology.* James J. McDermott, *Technical Assistant.*

CONTROL SERVICE.

Henry D. Haskins, B.Sc., *Official Chemist, Fertilizer Control.*
Philip H. Smith, M.Sc., *Official Chemist, Feed Control.*
Lewell S. Walker, B.Sc., *Assistant Official Chemist, Fertilizer Control.*
Frank J. Kokoski, B.Sc., *Analyst, Feed and Fertilizer Control.*
George B. Dalrymple, *Analyst, Feed and Fertilizer Control.*
Frederick A. McLaughlin, B.Sc., *Microscopist, Feed Control.*
James T. Howard, *Inspector, Feed and Fertilizer Control.*
Miss Cora B. Grover, *Stenographer, Feed and Fertilizer Control.*
Patrick E. Bransfield, B.A., *Specialist, Poultry Disease Elimination.*
Miss Alice Norcross, *Analyst, Poultry Disease Elimination.*
Miss Rebecca L. Mellor, *Clerk, Poultry Disease Elimination.*

REPORT OF THE DIRECTOR

Sidney B. Haskell.

SIGNIFICANT DEVELOPMENTS OF THE YEAR.

The best portrayal of the work of the year ending December 1, last, is in terms of service to the agricultural industries of the State, rather than in terms of the work of the several departments of the Experiment Station. In the following paragraphs, therefore, we have attempted to state the more important events of the year, classified as just indicated.

Animal Husbandry and Dairying.

The most important agricultural industry of the State is dairying, whether the basis of judgment be total value of product, area of land used in production, or numbers of men and women engaged in the industry. Contributions to this great industry are being rendered by four different departments of the Experiment Station. The Department of Plant and Animal Chemistry carries on studies in animal nutrition and on the properties of feeding stuffs. The Departments of

Agronomy and of Botany are associated in certain studies with reference to crops produced for feed for dairy animals; and the Department of Agricultural Economics is making a thoroughgoing study of our dairy market.

In the studies in animal nutrition two projects of great promise are: first, a study of substitutes for milk in the rearing of dairy calves; and second, the role of mineral constituents in the ration of dairy animals. In both cases the project bears on an economically significant problem. The relatively high price at which most milk produced in Massachusetts is sold makes its use for animals economically impracticable; whereas the poverty in lime of many Massachusetts soils makes the study of the role of mineral supplements essential. A progress report on the former project has been prepared for publication, and will shortly be printed as a Station bulletin.

In the agronomic field the most significant work now under way is study of the improvement of permanent pastures. The fact that such improvement is possible has been abundantly demonstrated. The next step must be to carry this work into the field to determine facts as they apply to different soil types and pasture conditions in the several geographical subdivisions of the State. This work is exceedingly important; for our New England dairymen, operating usually on rather poor pastures, often overgrown with brush and weeds, are finding increasing difficulty in competing with dairymen located where pastures are still in better condition.

Finally, the study recently completed on the New England dairy market, supported cooperatively by the College and the Bureau of Agricultural Economics of the United States Department of Agriculture, is of outstanding significance. For the first time facts relating to the marketing problem of the Massachusetts and New England dairy industry are brought together within the compass of a single volume. This work when published should be of immense value to the farmers of the State, as a basis for developing their marketing program.

Fruit Production.

Five different departments of the Experiment Station have cooperated this past year in furthering projects having to do with the production and marketing of Massachusetts fruit. These are the Departments of Pomology, Entomology, Botany, Plant and Animal Chemistry, and Agricultural Economics.

At the home station, results secured in experimental orchards show strikingly the superiority of the sod mulch with nitrate method of treatment over against cultivation of the producing orchard. As far as is known to us, the facts in this comparison have been established for the first time. The significance to our Massachusetts orchard industry lies in the fact that most of our orchards are located on hilly land, on which the advantage of the sod mulch system of management over against cultivation is obvious. The other work of the department, having to do particularly with methods of tree and soil management, is of increasing value with every passing year.

The work in nursery certification carried on under the supervision of the Station, but without cost to the State or drain on Experiment Station funds, and under the general auspices of the Massachusetts Fruit Growers' Association, has progressed rapidly during the year. The following table shows the progress of the work since it was initiated in 1921:

Year	Number of Trees Certified	Number of Trees Refused	Total	Number of Nurseries Examined
1921	2,580	267	2,847	1
1922	8,437	438	8,875	2
1923	65,910	905	66,815	3
1924	125,609	3,505	129,114	6

The success of the work thus far has abundantly justified the expense of the original research project.

In disease control studies the Department of Botany has brought to a successful close its investigation of apple scab control in the eastern part of the State. As a result of the work of the Station, apple scab is being controlled to a very

large degree. The season's work also contributed to our knowledge of the relative values of dusts versus sprays in controlling apple diseases, and to the development of a treatment calendar for each general material. From Entomology also are several distinct contributions: first, in the study of the life history of the codling moth with particular reference to control other than that now secured through the calyx spray; secondly, through additions to our knowledge of the life history of scale insects; and finally, in a study of the possible injurious effect of Scalecide, a type of miscible oil. In the latter case, contrary to expectations, anticipated injury has not yet materialized.

Of significant service to the fruit growing interests of the State has been the work of the Department of Agricultural Economics in studies on the costs of marketing apples. A manuscript giving complete report on this subject was submitted just as the year was drawing to a close, and will be published in the fairly near future.

Vegetable Gardening.

The research work of the Market Garden Field Station was seriously disorganized during the year by the transfer of the plant from Lexington to Waltham. Little could be done in the way of following up regular projects from the Field Station. However, the work of the Department of Entomology on the control of the squash vine borer is a distinct and valuable contribution to the vegetable growing industry of the State. An insect causing serious economic loss, which formerly was practically uncontrollable, can now be controlled. By-products of this investigation were the discovery of the possible role of nicotine as an ovicide, and work initiated for the purpose of activating nicotine and in this way enabling our growers to secure better results at lower costs. The work of this same department on control of the destructive onion thrips, and of the Department of Botany on control of onion smut are both important contributions to our vegetable growing industry.

During the year a cooperative agreement was entered into with the Bureau of Plant Industry of the United States Department of Agriculture, having for its objective the determination of the relation between varieties of sweet corn and time of planting, to susceptibility to corn borer attack. The project contemplates at least three years of observation before the facts of the case may be considered as having been even indicated.

The Cranberry Industry.

The two outstanding services of the Cranberry Station have been its contribution to our scientific and practical knowledge regarding the control of injurious insects, and its work with reference to frost predicting. In the former activity the results of twelve years' work are being brought together in a single manuscript, which will probably be offered for publication during the coming year. In the latter, organization has been perfected through which frost warnings are distributed by telephone throughout the cranberry growing section, at the expense of the cranberry growers. It is also planned to get out a forecasting manual for the growers, through which, by the use of data taken on their own bogs, they may predict the probability of local frosts with at least a fair degree of accuracy.

Work was continued on the blueberry investigation started some years ago in cooperation with the United States Department of Agriculture. A system of pruning the bushes was inaugurated with gratifying results. The plantation is continually being improved and the crop of the past year was the largest which we have as yet secured.

Poultry Husbandry.

The main projects in poultry husbandry are continuing ones, and in no one year can results be said to be particularly outstanding. Gains already made in breeding for high production were maintained; there was a decrease in mortality in the laying flock; through the granting of additional clerical help, much of the material collected through the past eleven years has been analyzed and submitted for publication. The new equipment granted by the State has been of immense assistance in enabling the Station to carry on this work in an effective and thoroughgoing way.

The cooperation of the Department of Veterinary Science in carrying forward research projects with reference to diseases of our domestic poultry and in making diagnoses showing the cause of death have been of great assistance. Likewise the work being done by this department in the administration of the law to reduce or eliminate certain poultry diseases is of very definite service to the Massachusetts poultry industry. Through the work thus carried on it will shortly be possible for Massachusetts poultrymen to purchase hatching stock and day-old chicks from known sources practically disease free. The work done under this law has been increasing annually. The record of number of birds tested and percentage of infection found in the testing work of the last four seasons is as follows:

Year.	Number of Birds Tested.	Percentage of Infection Found.
1920-21	24,718	12.50
1921-22	29,875	12.65
1922-23	33,602	7.60
1923-24	59,635	6.53

The number of disease-free flocks found increased from 25 in 1920-21 to 38 in 1923-24.

Soil Fertility and Plant Growth.

Many different departments of the Experiment Station contribute to work on this subject. Basic studies are being made by the Departments of Plant and Animal Chemistry and of Microbiology; the Department of Botany is carrying on a study relative to effective control of light, particularly in greenhouse culture; and the Department of Agronomy is initiating field experiments on a large scale. The new work started during the year includes a study of crop effect and rotation problems with reference to the onion and tobacco industries of the Valley. Of necessity work such as this must be carried on in a long-time project.

Tobacco Growing.

The newly organized research work on tobacco is just completing its second season. An outstanding result is indication of the depressing effect of timothy cover crop on yield and quality of the tobacco crop. This result is contrary to prevalent ideas on the subject, but is confirmed by three years' work carried on on the Tillson Farm. It warrants further investigation. Most of this newly organized field work is under the supervision of the Department of Agronomy.

The Department of Botany completed its work on wildfire during the year. The seed-bed treatment developed at this Station in cooperation with the Connecticut Station has proven to be at least fairly effective in controlling this most destructive disease. The possibility of extensive field infestation depends mainly on weather conditions. No successful field control has yet been developed; and in view of the uncertainties as to its need would probably not be widely utilized by growers even if developed.

Continued work of the Department of Botany at Tillson Farm has shown the depressing effect of lime on tobacco, particularly in a field infested with black root-rot. The timothy cover crop failed to remedy this condition, despite the fact that it was supposed to be effective in this way.

The new equipment granted by the Legislature of 1923-24 has enabled the Station to carry on this comparatively new work much more efficiently than could otherwise have been possible.

CATALOG OF EXPERIMENT STATION PROJECTS.

The list of projects in force as of January 1, 1925, and the industries of the State to which these projects apply, together with names of project leaders, are shown in the following table:

CATALOG OF ACTIVE PROJECTS, JANUARY 1, 1925.

Project Number, Title and Leader	Fruit Production	Tobacco Growing	Vegetable Gardening	Crop Protection	Soil Fertility and Plant Growth	Animal Husbandry	Poultry Husbandry	Agricultural Economics	General Field Crops
	Service of Project								
Agricultural Economics									
7 Boston food supply study. Professor McFall								*	
8 Study of the costs of marketing apples. Assistant Professor Jefferson	*							*	
Agronomy									
1 Investigation of the value of Hubam or annual sweet clover as compared to the biennial clovers. Professor Michels					*	*			*
2 Tobacco cropping system investigation. Assistant Professor J. P. Jones and Professor Anderson		*			*				
3 Soil fertility studies on the South Soil Test. Assistant Professor J. P. Jones					*				
4 Study of residual effects of fertilizers. Assistant Professor J. P. Jones					*				
5 A field study of tobacco production in Massachusetts. Professor Beaumont		*							
Botany									
1 Optimum conditions of light for plant resposse. Assistant Professor Clark			*		*				
3 Tobacco investigations. (A study of soil reactions as a means for control of root rots of tobacco; also study of effects of soil reaction alone on the growth and development of tobacco.) Professor Osmun and Professor Anderson		*		*	*				
5 Experimental spraying for control of cucumber mildew under glass. Assistant Professor Doran			*	*					
6 Investigation of onion diseases. Professor Osmun and Professor Anderson			*	*					
9 Investigation of a carrot blight. Assistant Professor Doran			*	*					
13 Ecological study of pasture vegetation. Professor Osmun and Director Haskell					*	*			
14 Investigation on control of tobacco wildfire. Professor Anderson		*		*					
16 Relation of soil character to occurrence of onion smut. Professor Anderson			*	*	*				
17 Study of the apple black rot control and the dusting schedule. Assistant Professor Doran	*			*					
18 Control of diseases of greenhouse vegetables. Assistant Professor Doran			*	*					
Plant and Animal Chemistry									
4 Record of the Station herd. Professor Lindsey						*			
14 A study of the availability of soil potash, with the object of developing a system of diagnosis for soils of the State. Professor Morse					*				
17 Investigation of the role of physical condition in artificial feeds for calves. Assistant Professor Archibald						*			
19 The value of inorganic calcium phosphate in the promotion of growth and milk production. Professor Lindsey and Assistant Professor Archibald						*			

CATALOG OF ACTIVE PROJECTS, JANUARY 1, 1925.—*Continued.*

Project Number, Title and Leader	Service of Project: Fruit Production	Tobacco Growing	Vegetable Gardening	Crop Protection	Soil Fertility and Plant Growth	Animal Husbandry	Poultry Husbandry	Agricultural Economics	General Field Crops
Plant and Animal Chemistry—Continued									
20 A study of the fundamental factors affecting the suspension, adhesiveness, toxicity and general efficiency of copper fungicides. Professor Holland and Mr. Gilligan	...	...	...	*	...	...	...	...	...
21 Study of nitrogen fixation in the presence of, or as the result of, growth of legumes versus non-legumes under certain defined agronomic conditions. Professor Morse	...	...	...	...	*	...	...	...	...
22 Determining the nutritive value of hydrolized sawdust. Professor Lindsey and Assistant Professor Archibald	...	...	...	...	...	*	...	...	...
23 Study of the coloring matter in cranberries. Professor Morse and Professor Chenoweth	*	...	...	...	...	...	...	...	...
Cranberry Station									
1 Injurious and beneficial insects affecting the cranberry. Professor Franklin	*	...	...	*	...	...	...	...	...
2 Cranberry disease work. (Co-operative, U. S. D. A.) Professor Franklin	*	...	...	*	...	...	...	...	...
3 Weather observations with reference to frost prediction. (Co-operative, U. S. D. A.) Professor Franklin	*	...	...	...	...	...	...	...	...
5 Blueberry investigations. (Co-operative, U. S. D. A.) Professor Franklin	*	...	...	...	...	...	...	...	...
6 Cranberry bud development investigation. Mr. Lacroix	*	...	...	...	...	...	...	...	...
Entomology									
4 Control of the squash vine borer. Assistant Professor Worthley	...	...	*	*	...	...	...	...	...
5 Control of the squash bug. Assistant Professor Worthley	...	...	*	*	...	...	...	...	...
9 Number of generations of codling moth in Massachusetts and whether spraying for a second generation is advisable. Assistant Professor Bourne	*	...	...	*	...	...	...	...	...
10 Dates of hatching of scale insects and when to spray for them. Assistant Professor Bourne	*	...	...	*	...	...	...	...	...
12 Determination of best strength of lime-sulfur. Assistant Professor Bourne	*	...	...	*	...	...	...	...	...
13 Study of possible injurious effects of Scalecide on trees. Assistant Professor Bourne	*	...	...	*	...	...	...	...	...
14 Does spraying orchards kill bees? Assistant Professor Worthley	*	...	...	...	...	...	...	...	...
15 A study of the factors influencing the efficiency of nicotine in dusts and spray mixtures. Assistant Professor Worthley	*	...	*	*	...	...	...	...	...
16 Investigation of materials which promise value in insect control. Assistant Professor Bourne	*	*	*	*	...	...	...	...	...
17 Control of onion thrips. Assistant Professor Bourne	...	...	*	*	...	...	...	...	...
Farm Management									
1 Investigation of farm organization and labor efficiency on Massachusetts farms. Professor Foord	...	...	...	...	...	*	...	*	*
2 A study to determine the competitive status of the more important agricultural enterprises of Massachusetts. Assistant Professor Abell	...	...	...	...	...	*	...	*	*

Market Garden Field Station										
7	Study of the factors influencing heading of greenhouse lettuce. Assistant Professor Tiedjens	...	...	*	...	...	...	...	...	...
8	Study of conditions affecting the production and vegetative propagation of Washington asparagus. Assistant Professor Tiedjens	...	...	*	...	...	...	...	...	...
9	Investigation of susceptibility to corn borer attack of varieties of sweet corn as influenced by time of planting. (Co-operative U. S. D. A.) Mr. Dempsey	...	...	*	*	...	...	...	...	...
10	Variety improvement through seed and root selection:									
	a. The improvement of beets (*Beta vulgaris*) through selection of roots and seed production.									
	b. The improvement of carrots (*Daucus carota*) through selection of roots and seed production.									
	Assistant Professor Tiedjens	...	...	*	...	...	...	...	...	...
Microbiology										
2	Soil fertility as influenced by micro-organisms in their relation to the presence and disappearance of organic matter. Assistant Professor Werkman	...	...	...	...	*	...	...	...	...
Pomology										
1	Study of interrelation of stock and scion in apples. Professor Shaw and Mr. Bailey	*	...	...	...	...	...	...	...	...
2	Study of the tree characters of fruit varieties. Professor Shaw and Mr. A. P. French	*	...	...	...	...	...	...	...	...
3	The genetic composition of peaches. Professor Shaw and Mr. Bailey	*	...	...	...	...	...	...	...	...
5	Comparison of cultivation and sod mulch in a bearing orchard. Professor Shaw	*	...	...	...	...	...	...	...	...
6	Comparison of clover sod and grass in sod mulch orchard. Professor Shaw	*	...	...	...	*	...	...	...	...
7	Test of fertilizers in a sod mulch orchard. Professor Shaw	*	...	...	...	*	...	...	...	...
8	Test of cover crops for apple orchards. Professor Shaw	*	...	...	...	*	...	...	...	...
9	Testing methods of pruning:									
	a. An experiment in pruning apples									
	b. Test of pruning methods on the Northern Spy and other varieties. Professor Shaw	*	...	...	...	...	...	...	...	...
12	Apple variety fruit spur study. Professor Shaw, Assistant Professor Drain and Assistant Professor C. P. Jones	*	...	...	...	...	...	...	...	...
13	Study of varieties of tree fruits. Professor Shaw and Mr. Raleigh	*	...	...	...	...	...	...	...	...
14	Study of the relation of winter injury of brambles to differential fertilization with potash salts. Professor Shaw, Assistant Professor C. P. Jones and Assistant Professor Clark	*	...	...	...	*	...	...	...	...
15	Orchard fertilization. Professor Shaw	*	...	...	...	*	...	...	...	...
16	Test of different amounts of nitrate of soda. Professor Shaw and Assistant Professor Drain	*	...	...	...	*	...	...	...	...
17	A study of the cultivation of the high bush cranberry (*Viburnum opulus*). Professor Shaw	*	...	...	...	...	...	...	...	...
18	Comparison of cultivation and heavy mulching for apples and pears. Professor Shaw	*	...	...	...	*	...	...	...	...
19	A study of the effects of fertilizer limitation on fruit plants. Professor Shaw	*	...	...	...	*	...	...	...	...
20	Test of fertilizers for pears. Professor Shaw	*	...	...	...	*	...	...	...	...
21	Study of fruit harvesting and storage. Mr. Raleigh	*	...	...	...	...	...	...	...	...
Poultry Husbandry										
1	Broodiness in poultry. Professor Hays	...	...	...	...	...	...	*	...	...
2	Breeding poultry for egg production. Professor Hays	...	...	...	...	...	...	*	...	...
3	A genetic study of Rhode Island Red color. Professor Hays	...	...	...	...	...	...	*	...	...
4	Determination of genetic laws governing results in inbreeding of poultry. Professor Hays	...	...	...	...	...	...	*	...	...
5	The hatchability of eggs. Professor Hays	...	...	...	...	...	...	*	...	...

CONTROL SERVICE.

In addition to carrying on investigations, the Experiment Station is required to perform certain control and regulative functions, as follows:

1. Inspection of commercial fertilizers.
2. Inspection of commercial feed stuffs.
3. Inspection of machinery and glassware used in the testing of dairy products.
4. Elimination of white diarrhoea in poultry.

Reports on all except the third of these are published separately, respectively in control bulletins Nos. 29 and 30, 28, and 27 of the Experiment Station.

The work of the year under the law providing for the inspection of dairy glassware is summarized below:

Certificates of proficiency awarded	42
Machines and apparatus inspected by Mr. Howard, November and December, 1924	117 places
Machines condemned	3
Minor repairs ordered on machines	14
Necessary re-inspections	4
Glassware calibrated	5,092 pieces
Glassware condemned	11 pieces

GENERAL ANALYTICAL AND DIAGNOSTIC WORK.

Since its very beginning the Experiment Station has been called upon to perform a large amount of miscellaneous diagnostic and analytical work. Diseased plants, specimens of insect injury, dead birds, and other materials are sent in for diagnosis. Soils, feeds, fertilizers, insecticides and fungicides, samples of milk and cream, the alimentary tract of animals supposedly poisoned, and many other things are submitted for analysis. Formerly this work was done free of charge. There is no doubt that this policy of making free diagnosis and analysis had great educational value. In recent years, however, the burden on the research forces of the Experiment Station has been increasingly great. This, together with the significant fact that many samples are submitted out of mere curiosity rather than on the basis of definite need for service, led to the imposition of a fee for performing the greater part of this work, exceptions being diagnoses of plant disease and insect injury. As a result, there has been a significant decrease in the amount of service requested. There has been criticism of the practice of making charges for this miscellaneous work. Many farmers and farm organizations feel that the Experiment Station is not now giving the service which it formerly did. It should be remembered, however, that because of reducing its activities in this direction the Station is able to do more work in the study of problems of vital significance to Massachusetts agriculture. Other than as above mentioned, this phase of the year's work does not differ markedly from that of other years.

ADVANCED REGISTRY TESTING OF PURE BRED COWS.

This work was started in 1902 on a very small scale. The work is operated on the basis of a revolving fund, and has no financial support from the State. Up to three years ago, a rather general and consistent increase was shown year by year. Owing probably to the current depression in agriculture with consequent diminished demand for pure bred stock, the work this past year was somewhat less than in the immediately preceding years. The following table shows the more important operations of the period in question:

SUMMARY OF TWO-DAY WORK, DECEMBER, 1923, THROUGH NOVEMBER, 1924.

Number of Cows Tested.

Month	Number of Supervisors Whole or Part Time	Guernsey	Jersey	Ayrshire	Shorthorn	Holstein	Totals
December	9	214	102	70	22	97	505
January	10	250	91	71	21	89	522
February	13	251	98	79	17	75	520
March	9	251	94	85	14	92	536
April	11	252	93	101	13	93	552
May	10	259	91	102	13	97	561
June	10	237	85	95	11	80	508
July	10	243	76	99	11	69	498
August	11	262	89	97	10	61	519
September	11	247	101	95	9	64	516
October	10	249	101	101	6	66	523
November	10	248	90	92	11	68	509
Totals	—	2963	1111	1087	157	951	6269

Number of Herds Visited.

Month	Number of Supervisors Whole or Part Time	Guernsey	Jersey	Ayrshire	Shorthorn	Holstein	Totals
December	9	35	15	7	2	10	69
January	10	38	13	8	2	11	72
February	13	40	13	9	2	13	77
March	9	41	12	7	2	10	72
April	11	39	11	10	1	11	72
May	10	42	11	8	1	13	75
June	10	41	12	9	1	13	76
July	10	41	13	8	1	11	74
August	11	43	12	7	1	11	74
September	11	40	13	8	1	11	73
October	10	38	14	7	1	11	71
November	10	38	13	7	1	12	71
Totals	—	476	152	95	16	137	876

The above compares with a total of 6270 tests for the year ending December 1, 1923. The number of cows on yearly test decreased in one year from 520 to 509; the number of farms visited remained practically the same.

HOLSTEINS. There were 10 men employed for seven-day work, 19 farms visited, and 86 reports turned in.

CHANGES IN STAFF

The changes in staff during the year are shown in the following table:

	Resignations	*Position*	*Appointments*	
		Analyst, Feed and Fertilizer Control	George B. Dalrymple	Jan. 1.
Jan. 15.	Harold F. Tompson	In Charge, Market Garden Field Station		
Mar. 31.	Charles O. Dunbar	Investigator in Chemistry	Gerald M. Gilligan	July 1.
June 30.	Robert L. Coffin	Investigator in Agriculture		
Aug. 1.	Anna M. Wallace	Curator in Botany	Gladys I. Miner (transfer)	Aug. 1.
		Technical Assistant, Department of Veterinary Science	James J. McDermott	Aug. 1
Sept. 1.	Arao Itano	Assistant Professor in Microbiology	Chester H. Werkman	Sept. 1.
Oct. 31.	Hazel Parker	Analyst, Poultry Disease Elimination	Alice Norcross	Oct. 27.
Nov. 1.	O. S. Flint	Analyst Poultry Disease Elimination (new title, Specialist)	Patrick E. Bransfield	Nov. 1.
Nov. 12.	Henry S. Green (retired)	Librarian	Basil B. Wood	Nov. 12.
Nov. 30.	Harold E. Wilson	Laboratory Assistant in Pomology		
		Investigator in Botany	Theodore T. Ayers	Nov. 16.
		Microscopist, Feed Control	F. A. McLaughlin	

PUBLICATIONS OF THE YEAR.

Annual Report.

Thirty-sixth annual report with index.

Bulletins.

No. 219. Combating Apple Scab, by William L. Doran and A. Vincent Osmun.
No. 220. Correlation Studies on Winter Fecundity, by F. A. Hays, Ruby Sanborn and L. L. James.

Bulletins, Technical Series.

No. 6. The Inheritance of Fertility and Hatchability in Poultry, by F. A. Hays and Ruby Sanborn.

Bulletins, Popular Edition.

No. 6. The Inheritance of Fertility and Hatchability in Poultry, by F. A. Hays and Ruby Sanborn.

Bulletins, Control Series.

No. 27. Control of Bacillary White Diarrhoea, 1923-24, by G. E. Gage and O. S. Flint.
No. 28. Inspection of Commercial Feedstuffs, by Philip H. Smith and Frank J. Kokoski.
No. 29. Inspection of Commercial Fertilizers, by H. D. Haskins, L. S. Walker and G. B. Dalrymple.
No. 30. Inspection of Lime Products used in Agriculture, by H. D. Haskins, L. S. Walker and G. B. Dalrymple.

Meteorological Reports.

Nos. 421-432, inclusive.

Scientific Contributions.

No. 19. The Biology of Trichopoda Pennipes Fab., a Parasite of the Common Squash Bug, by Harlan N. Worthley. In Psyche, Vol. 31, Nos. 1 and 2, February and April, 1924.
No. 22. Oxidase Activity in Varieties of Apples, by Brooks D. Drain. In Proceedings of the American Society for Horticultural Science, 1923.
No. 23. The Effect of Sodium Hydroxide on the Composition, Digestibility and Feeding Value of Grain Hulls and Other Fibrous Material, by J. G. Archibald. In Jour. Agr. Research, Vol. XXVII, No. 5, February 2, 1924.
No. 25. The Loss of Calcium Carbonate in Drainage Waters as Affected by Different Chemical Fertilizers, by F. W. Morse. In Soil Science, Vol. XVII, No. 3, March, 1924.
No. 26. The Problem of Pastures in Semi-Waste Lands of New England, by S. B. Haskell. In Jour. Amer. Soc. Agron., Vol. 16, No. 3, March, 1924.
No. 27. Overwintering of Tobacco Wildfire in New England, by P. J. Anderson. In Phytopathology, Vol. XIV, No. 3, March, 1924.
No. 28. Adsorption and Absorption of Bases by Soils, by C. P. Jones. In Soil Science, Vol. XVII, No. 3, March, 1924.
No. 29. The Higher Cost of Food in Massachusetts, by R. J. McFall. In Quarterly Publication, American Statistical Association, Sept., 1924.
No. 31. Stimulation of Plant Growth by Means of Electric Lighting, by Victor A. Tiedjens. A paper presented before the Eighteenth Annual Convention of the Illuminating Engineering Society, October, 1924.

METEOROLOGICAL OBSERVATION.

Department of Meteorology.

PROF. J. E. OSTRANDER, HEAD

ANNUAL SUMMARY FOR 1925.

Pressure (in Inches)

Maximum reduced to freezing	30.44 Jan. 2nd, 9 A.
Minimum reduced to freezing	28.88, Dec. 13th, 7 P.
Maximum reduced to freezing and sea-level	30.77, Jan. 2nd, 9 A.
Minimum reduced to freezing and sea-level	29.19, Dec. 13th, 7 P.
Mean semi-daily reduced to freezing and sea-level	30.010
Annual range	1.58

*Air Temperature (in Degrees Fahr.)

Highest ....97.0, Aug. 7th, 1:00 P.
Lowest ....-8.0, Jan. 27th 6:00 A. Jan. 28th, 6:00 A.
Mean hourly 46.6
Mean of means of max. and min 46.7
Mean sensible (wet bulb) 41.0
Annual range 105.0
Highest mean daily ....78.8, Aug. 7th
Lowest mean daily ....-0.3, Jan. 27th.
Mean maximum 57.8
Mean minimum 35.7
Mean daily range 22.1
Greatest daily range..43.5, Oct. 23rd., 24th.
Least daily range ....3.0, Feb. 5th.

Humidity

Mean dew point 36.4
Mean force of vapor 362
Mean relative humidity 73.9

Wind

Prevailing direction ....West

Summary

North ....10 per cent
North Northeast .... 9 per cent
South .... 9 per cent
South Southwest ....19 per cent
Northwest .... 9 per cent
Other directions ....41 per cent
Total movement ....53.855 m
Greatest daily movement..553m., Mar. 12th
Least daily movement.....22 m., Dec. 12th
Mean daily movement..............147 m
Mean hourly velocity ....6.1 m
Maximum pressure per square foot, 23.5 lbs., =69 m. per hour, Apr. 14th, 3 P., N. W.
Maximum velocity for 5 minutes, 42 m. per hour, July 13th, 1 P., S. W.

*Temperature in ground shelter.

Precipitation (in Inches)

Total precipitation, rain or melted snow 30.96
Snow total in inches 45.0
Number of days on which .01 or more rain or melted snow fell 96

Weather

Mean cloudiness observed ......41 per cent
Total cloudiness recorded by Sun Thermometer ......1637 hrs.=37 per cent.
Number of clear days 141
Number of fair days 145
Number of cloudy days 80

Bright Sunshine

Number of hours recorded, 2838 hrs.=63 per cent.

Dates of Frosts

Last ....May 2d
First ....Sept. 24th

Dates of Snow

Last ....April 8th
First ....Nov. 9th
Total days of sleighing 54

Gales of 50 or More Miles Per Hour

Jan. 1st, 58m, N. W.; 11th, 67m, S.S.E.; 21st, 63m, N.W.; 26th, 56m, N.W.
Mar. 11th, 57m, N.E.; 12th, 63m, N.N.E.; 28th, 59m, W.N.W.
Apr. 14th, 69m, N.W.; 51m, 24th, N.N.W.
May 18th, 52m, S.
July 13th, 56m, S.W.
Nov. 17th, 55m, N.N.W.

REPORT OF THE TREASURER

F. C. KENNEY

United States Appropriation, 1923-24.

Dr.	Hatch Fund.	Adams Fund.
To receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1924, under acts of Congress approved March 2, 1887 and March 16, 1906	$15,000.00	$15,000.00

Cr.

Adams:	
By salaries	**$15,000.00**
Hatch:	
By salaries	**$15,000.00**

State Appropriations, 1923-24.

Cash balance brought forward from last fiscal year	
Cash received from State Treasurer	$119,790.75
fees	40,733.93
sales	9,710.88
miscellaneous	393.54
	$170,629.10

Cash paid for salaries	$73,870.99
labor	19,015.27
stationery and office supplies	666.31
scientific supplies	2,770.72
feed	1,254.71
seeds, plants and sundry supplies	3,151.64
fertilizers	1,502.08
communication service	1,021.94
traveling expenses	5,929.08
transportation of things	862.98
publications	2,262.23
heat, light, water and power	1,240.26
furniture and fixtures	767.36
library	1,163.99
scientific equipment	633.49
livestock	—1,606.16
tools and machinery	2,264.09
buildings and land	3,001.98
contingent	17.79
remitted to State Treasurer	50,838.35
	$170,629.10

MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION

TECHNICAL BULLETIN No. 6 JANUARY, 1924

THE INHERITANCE OF FERTILITY AND HATCHABILITY IN POULTRY

By F. A. HAYS and RUBY SANBORN

Determination of fact as to inheritance of characters is essential to successful poultry breeding. This work is peculiarly within the province of the Agricultural Experiment Station, for records must be made on large numbers of individual birds, the work must extend over a period of years, a wearisome amount of data must be preserved. The data recorded in this bulletin are the result of eleven years' work. Individual records were made on 886 birds. Resulting data are now analyzed statistically in the light of all that genetic science has to offer. It is through work such as this that a basis of sound fact, in poultry breeding work, will ultimately replace one based largely on opinion and tradition.

Requests for Bulletins should be addressed to the

AGRICULTURAL EXPERIMENT STATION

AMHERST, MASS.

Publication of this Document approved by the Commission on Administration and Finance

THE INHERITANCE OF FERTILITY AND HATCHABILITY IN POULTRY.

By F. A. Hays and Ruby Sanborn.

Introduction.

The importance of a thorough understanding of the mode of inheritance of factors affecting fertility of hens' eggs needs no stressing. Neither does the value of a complete understanding of the way hatching power of eggs is inherited require emphasis, for the proper functioning of the factors for high fertility and high hatchability is of fundamental and vital importance to every poultry breeder.

The purpose of this report is to consider only the question of the inheritance of fertility[1] and hatchability[2] from as many angles as our data will permit. The inheritance of these two characteristics is discussed first from the standpoint of the dams and then from the standpoint of the sires. The fact should be recognized at the outset that numerous variable environmental factors such as weather conditions, health of birds, exposure of eggs, variation within the same and different incubators, etc., are in constant operation. The combined action of these constantly varying environmental factors may largely obscure the inherent capacity of the bird to produce fertile eggs that are largely hatchable. A further lack of knowledge of the fundamental factors concerned in breeding for high fertility and high hatchability, as pointed out by Dunn ('23), makes proper matings impossible.

Data Available.[3]

The data used in this bulletin have been collected each hatching season from 1913 to 1923. All records kept represent the pullet year or cockerel year unless otherwise stated. All records were made by pedigreed Rhode Island Red birds. The attention of the reader is called to the fact that stud matings have been used almost exclusively and this will account for a lower degree of fertility than might be obtained from pen matings. Uniform methods of incubation have been used and care has been taken to maintain a definite system of management throughout the eleven-year period. Only females whose daughters were trap-nested are included in this report.

PART I.

The Female's Rôle in the Inheritance of Fertility and Hatchability.

Fortunately a measure of individual fertility and hatchability is possible in the female. The accuracy of such a measure depends very largely upon the number of eggs laid by the pullets in question during the hatching season. Some pullets will lay fifty eggs during a two months' incubation season, while others may lay as few as five or ten eggs. Fertility and hatchability records on the first type would certainly be much more significant than those on the second type. The major portion of the records here reported upon were made between the hatching dates of March 25 and May 15 of the respective years. In some cases chicks were hatched beyond the above dates, but not as a rule. Since the flock was being bred for egg production, considerable care was exercised to use pullet breeders that would lay a goodly number of eggs during the hatching season.

Section 1. Correlation between Fertility and Hatchability.

A hen to be able to produce a large number of chicks must lay highly fertile eggs. Furthermore, her eggs must hatch well. In ordinary usage, good hatching hens are those from which almost all eggs laid give rise to vigorous chicks. Fertility and hatchability are bound together in the sense that there can be no hatch-

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[1] *The term fertility as used here refers to the percentage of eggs that are fertile; the test being made on the fifth day of incubation.*

[2] *The term hatchability as used here refers to the percentage of fertile eggs hatched.*

[3] *The data used in this report were collected by Dr. H. D. Goodale until 1921; for the year 1922, by Professor William Sanctuary and the junior author.*

ability without fertility; but there may be one hundred per cent fertility and zero hatchability, or there may be only five per cent fertility and one hundred per cent hatchability.

The above facts show that the coefficient of correlation between fertility and hatchability could neither be zero nor negative. Pearl ('09) found a correlation of $-.127 \pm .071$ between the percentage of infertile eggs and the percentage of fertile eggs hatched from pullets. Such a factor, in view of the large probable error, indicates no sensible correlation between the degree of fertility and the percentage of fertile eggs hatched.

In table 1 presented below, the percentage of fertile eggs from 758 pullets is correlated with the percentage of fertile eggs hatched. These percentages represent each pullet's average fertility record and her average hatching record for the season. The records were obtained in eleven breeding seasons. The table includes all pullets used as breeders during the period covered, except those showing zero fertility. The zero-fertility class had to be omitted because zero fertility always means zero hatchability, and if the fifty-three pullets that laid no fertile eggs were included, a spurious correlation would arise and not the true correlation coefficient.

TABLE 1.—*Correlation Between Fertility and Hatchability.*

	Pullets' Hatchability, Per Cent.																				
Pullets' Fertility, Per Cent.	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	f.
1–4																					
5–9	4																			2	6
10–14	2						1						1							1	5
15–19	2					1					1		1							1	6
20–24	5					1	2				1	1				1	1	1		1	14
25–29	1		1			2					1		2			2	1			2	12
30–34	3		1			1				1						1				3	10
35–39	1					1			1		1	1	5	1		1				2	14
40–44	3		1	1				1			2				4		1			1	14
45–49	3					1			2				1		2	3			2		14
50–54	3				1			1			1	2	2	1	1	4	1		1	5	23
55–59	1	1			1			1	1	1			1	1	1	2			1	1	13
60–64		1		1	2		2					1	3	2	2	6	1		2	1	24
65–69	6	1		1	2	2	2	1	1	2	2	1	7	1	3	4	3			1	40
70–74	5	1	1			3	1	2		1	2	3	4	3	2	3	6	2		2	41
75–79	4	1	3	1	1		2	1	1	3	1	4	3	1	3	5	1	3	2	2	42
80–84	1	2	2		4		2	1	2		7	2	6	6	3	4	4	4		3	53
85–89	5	1		3	3	1	3	7	4	7	3	5	7	9	9	4	2	2	1	1	77
90–94	10		3	1	2	3	4	4	3	2	3	3	11	8	5	8	9	8	4		91
95–100	28	5	4	10	5	7	10	9	9	7	13	12	20	22	15	22	17	18	20	6	259
f.	87	13	16	18	21	23	29	28	24	24	38	35	74	55	50	70	47	38	33	35	758

Constants calculated from Table 1.

Mean fertility	$.688272 \pm .005466$
Fertility standard deviation	$.2231 \pm .003865$
Mean hatchability	$.637875 \pm .007119$
Hatchability standard deviation	$.2906 \pm .005034$
Coefficient of correlation	$.0672 \pm .024390$

Table 1 gives a positive correlation coefficient of $.0672 \pm .02439$ which must be interpreted in the light of a probable error of more than one-third as signifying

almost complete independence between degree of fertility and hatchability.

From the genetic standpoint, the results in table 1 are significant. The table shows that a flock of pullets may carry the factors that are conducive to high fertility and yet lack the ability to be good hatchers. Stated simply, these results mean that the degree of fertility in a hen's eggs is an entity independent from the hatchability of her eggs.

The mean fertility shown in table 1 is .6883, while the mean hatchability is .6379. Of the total eggs laid by these pullets during the hatching season, 68.83 per cent were fertile, and 63.79 per cent of these fertile eggs hatched. Two possible avenues are open for increasing the number of chicks per pullet. *First*, Increase the percentage of total eggs that are fertile. *Second*, Increase the percentage of fertile eggs that hatch. Selection for high fertility and high hatchability is possible only where hens are used as breeders. Hens have been used to only a very minor extent in this flock. Hence there has not been much progress in fertility and only moderate progress in hatchability, as will be shown in section 17 of this bulletin. The general deduction must be made, therefore, from the study of table 1, that fertility and hatchability are independent of each other. The stability of each characteristic may next be considered.

Section 2. The Constancy of Fertility in Hens.

In order to test the constancy of fertility in hens, the records of 253 female breeders that were used first as pullets and again as yearlings have been placed in table 2. In practically all cases a different male was mated to these females the second year. If there is a sensible correlation in fertility between the pullet-year record and the yearling record from the same hens, the natural assumption must be that degree of fertility is more or less constant in the female, regardless of the male to which she is mated.

TABLE 2. — *Correlation Between First and Second-Year Fertility.*

	Yearling Hens' Fertility, Per Cent.																				
Pullets' Fertility, Per Cent.	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	f.
0–4	3													1						5	9
5–9									1										1		2
10–14							1			1										1	3
15–19		1			2																3
20–24																1		1	2	1	5
25–29	1													1						1	3
30–34														1							1
35–39				1				1				1						1		2	6
40–44	1																			2	3
45–49	1										1			1				1	1	2	7
50–54	1		1															3		2	7
55–59														1						2	3
60–64																	2		3	1	6
65–69	1			1		1								1	1		1	2	3	4	15
70–74	2							1			1			1				1	3	3	12
75–79																1	1	2	2	3	9
80–84	2			1	2										3	1	1	2	2	6	20
85–89	1							1	1		1	2	1		2	1	2	1	2	5	20
90–94			1		2				1				2	1	1		3	7	5	19	42
95–100	2		1				1			1		1		3			7	3	8	50	77
f.	15	1	3	3	6	1	2	3	3	2	3	4	3	11	7	4	17	24	32	109	253

Constants calculated from Table 2.

Pullets' mean fertility	.7589± .011288
Pullets' standard deviation	.2662± .007982
Yearling hens' mean fertility	.7825± .012111
Yearling hens' standard deviation	.2856± .008564
Coefficient of correlation	.2733± .039238

The mean fertility of the birds used in table 2 was slightly greater for the yearling than for the pullet-year. The difference, .0236±.016579, is not great enough to be significant. The range of variability measured by the standard deviation is slightly wider as yearlings than as pullets, but the closeness of agreement in the two years signifies a degree of fixedness. From the breeding standpoint, the chief deduction that may be made from a study of table 2 is that the percentage of fertility for a pullet is a good guide as to her probable fertility as a yearling.

A positive coefficient of correlation, .2733±.039238, between the first and second year fertility supports the view that fertility is a trait that is fairly constant for the individual hen. Lamson and Card ('20) have pointed out this fact in Leghorns. Pearl ('09) found a negative correlation of .1112±.092 between infertility the first year and the second year in Barred Plymouth Rocks. Our data, however, indicate that a bird with good fertility as a pullet will probably show good fertility as a yearling.

Section 3. The Constancy of Hatching Power in Hens.

The group of 253 birds studied in table 2 are correlated for hatchability in table 3 to discover if there is a relationship between the percentage of fertile eggs hatched as pullets and as yearlings. In other words, does hatchability approach any degree of constancy in the same individual in two successive years? Does a good hatching record as a pullet mean a good hatching record as a yearling?

TABLE 3. — *Correlation Between First and Second-Year Hatchability.*

Pullets' Hatchability, Per Cent.	Yearling Hens' Hatchability, Per Cent. 0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	f.
0–4	10				2		1					2	1	1	2				1		20
5–9	2				1							1				1					5
10–14	3						1				1										5
15–19	3				1		1		1			1									7
20–24	3																				3
25–29	2	2			1							1			1		1				8
30–34								1				1			1			1	1		5
35–39	3			1			2	1					1								8
40–44		2	1		1		1	1					2	2							10
45–49	1					3	1		1		2					1					9
50–54	5		2		2	1		1			2		1	2	1		1	1		1	20
55–59	1		2	1		1	3		2	3	1		2					1			17
60–64	1				1				3	3	2	1		1	2	1	2	1		2	20
65–69	2		1	1								1	3	3	2	2	1	2	1		19
70–74	2		1	1					1	1		1	2	1	1	5	1	1	3	1	22
75–79	4					1	1	1	1	1	3		3	1		3	2	2	1		24
80–84									1		2	2		2			1				8
85–89	1	1					1			1	1		3		2	4	1	2		1	18
90–94	1									1	2		1			1	3	4		1	14
95–100	2										1			4			2	1		1	11
f.	46	5	7	4	9	6	12	5	10	10	17	11	19	17	12	18	15	16	7	7	253

Constants calculated from Table 3.

Pullets' mean hatchability	.5678±.011313
Pullets' standard deviation	.2668±.008333
Yearling hens' mean hatchability	.4791±.012963
Yearling hens' standard deviation	.3057±.009166
Coefficient of correlation	.4346±.034409

The mean hatchability for pullets is .5678±.011313. The mean hatchability for the same birds as yearlings is .4791±.012963. There is a difference of .0887±.0172 in favor of using pullet breeders. This difference is significant in the light of its probable error. Stewart and Atwood's ('09) records with White Leghorns do not agree with these results. They found both the mean fertility and mean hatchability to be higher in hens than in pullets. Their records are scarcely comparable with ours because they did not compare the same birds. Furthermore, in a yearling or two-year-old flock, most of the poor hatchers will have been discarded if they were tested as pullets. Pearl ('09) obtained a slightly higher mean fertility in the pullet year and an insignificant difference in hatchability between pullets and yearlings, using the same flock of Barred Plymouth Rocks.

The range of variability measured by the standard deviation is significantly greater in the yearling hens. This difference may possibly be ascribed to variability in physical condition in the older birds. Hatchability, however, seems to be a trait that behaves with a good deal of constancy in hens. This fact makes the individual hatching record valuable, at least in making use of a hen for several years to increase flock numbers. The ability of the hen to transmit this hatching power to her daughters will be considered in section 5.

The coefficient of correlation calculated from table 3 is .4346±.034409. Hatchability is therefore more constant than fertility, for the coefficient for fertility in the same flock was only .2733. In breeding for high hatchability there is ample justification for discarding the poor hatchers the first year and retaining the good hatchers to perpetuate the flock.

Section 4. Correlation in Fertility between Mothers and Daughters.

In order to discover if there is any relationship between mothers and daughters in degree of fertility, the average fertility of pullet breeders has been correlated with each of their daughters that were used for breeding as pullets. In case only one daughter was used, there was but one insertion in the table. If a pullet dam had more than one daughter used as a breeder she is paired with each of these daughters and an insertion made in the table.

TABLE 4. — *Correlation in Fertility Between Mother and Daughter.*

		Daughters' Fertility, Per Cent.																				f.
		0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	
Dams' Fertility, Per Cent.	0–4																					
	5–9																					
	10–14																					
	15–19									1									1			2
	20–24																					
	25–29	1																				1
	30–34												1					2		1	1	5
	35–39						1								1		1			1	1	5
	40–44				1						1	1			1	2			2	1	4	13
	45–49								1			2						2			3	8
	50–54										1				1	1			2	1	2	8
	55–59	1																1		3	4	9
	60–64	2				1					1			1		1		2	1	1	7	17
	65–69	3		2		2	1					2		1	2	1	1	2	3	3	8	31
	70–74	2				1		1	1	1		1			2	1	5	2	3	4	13	37
	75–79								1			1		1	4	2	2	3	2	3	5	24
	80–84	5				3	1	1				2		1	1	4	2	1	2	7	17	47
	85–89	5	1		1.			2	2	3	1	1	2	2	1	2	4	3	7	10	17	64
	90–94	12	1	1	1	1.	3	1	1	3	4	5		3	7	6	4	5	10	11	45	124
	95–100	23	4	2	4	6	5	5	7	6	6	8	9	15	20	21	23	31	44	45	132	416
	f.	54	6	5	7	14	11	10	13	14	14	23	12	24	40	41	42	54	77	91	259	811

Constants calculated from Table 4.

Dams' mean fertility	.8765±.003503
Dams' standard deviation	.1479±.002477
Daughters' mean fertility	.7378±.006831
Daughters' standard deviation	.2884±.004830
Coefficient of correlation	.0147±.023679

The standard deviation in dams in fertility is .1479, while the standard deviation of their daughters is twice as great or .2884. There is a positive correlation coefficient in fertility of .0147±.023679 between the dams and the 811 daughters that were used as breeders. Since this coefficient is less than its probable error, it can have no significance. This table must therefore indicate that a pullet with low fertility is as likely to give daughters high in fertility as is a breeding pullet that shows high fertility herself. These observations are essentially in agreement with Pearl ('09), for he found a negative correlation of .035±.072 in infertility between mother and daughter. The conclusion seems justified, therefore, that the fertility of the dam's eggs is no indication as to the probable fertility of her daughter's eggs. In section 2, the fertility record of a pullet was shown to be a guide as to her second-year fertility. Since the dam's fertility record is not a dependable index of her ability to breed true for fertility, the only satisfactory test is the progeny test, for fertility seems to depend upon many as yet unrecognized factors, or else is not an inherited characteristic.

Section 5. Correlation in Hatchability between Mothers and Daughters.

The identical group of dams and daughters used in table 4 has again been correlated in table 5, using percentage of fertile eggs hatched.

TABLE 5. — *Correlation in Hatchability Between Mother and Daughter.*

Dams' Hatchability, Per Cent.	Daughters' Hatchability, Per Cent. 0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	f.
0–4																					
5–9							1														1
10–14													1								1
15–19	1																				1
20–24	1										1										2
25–29	3											2									5
30–34	1	1		1			1			1		2	1				1				9
35–39	4					2	1						5	3	1		2	1			19
40–44	6			2	2				3	3	1	1		1			1	1		3	24
45–49	7	3	2	1	2	1		3			1	2	3		2						27
50–54	7	2	1		1	1	1		3	1	1	1	3	1	1	7	1	1	1	2	36
55–59	10	1	3	1	4	4	3	2	4	1	2	3	9	3	5	5	2	1	3	1	67
60–64	13				3	3	4	4	3	6	3	2	8	4	7	9	4	3	3	5	84
65–69	18		1	2	4	2		2	4	2	5	4	11	6	4	7	5	2	4	3	86
70–74	8	2	1	2	2	2	4	3	1	1	9	3	6	2	3	8	5	4	3	1	70
75–79	28		4	4	3		4	3	2	4	6	2	7	12	5	8	6	9	1	7	115
80–84	11			2		1	6	3	2	2	3	4	8	5	6	6	4	10	5	4	82
85–89	11	3	3	1	1	3	2	2		1	1	4	3	8	6	9	6	6	4	5	79
90–94	6	2	1	1		2	1	3	1	2	3	2	7	6	7	7	5		6	5	67
95–100	2					2		2			2	2	3	2	3	4	6	2	3	3	36
f.	137	14	16	17	22	23	28	27	23	24	38	34	75	53	50	70	48	40	33	39	811

Constants calculated from Table 5.

Dams' mean hatchability	$.7064 \pm .003891$
Dams' standard deviation	$.1643 \pm .002752$
Daughters' mean hatchability	$.5091 \pm .007340$
Daughters' standard deviation	$.3099 \pm .005190$
Coefficient of correlation	$.1960 \pm .022805$

Table 5 undoubtedly shows that hatching power is transmitted from mother to daughter, yet while the dam's mean hatchability is .7064, her daughter's mean was only .5091. The standard deviation of dams was .1643 and their daughters' standard deviation was .3099. Thus the range of variation in daughters as measured by the magnitude of their standard deviation is almost double that of their dams. Such would be the case if a dominant factor is present for high hatchability. This relative variability is in exact agreement with the same observation on fertility as pointed out in section 4.

There is a positive correlation coefficient of $.1960 \pm .022805$ between dams and daughters in hatchability. During the progress of the experiment, the pullet breeders used on successive years came from pullet mothers that showed a good hatching percentage. In other words, the pullets that were used as breeders in any one year came from pullet dams that had laid eggs of good hatching power. According to Pearson ('03) rigid selection in parents may reduce the correlation between parent and offspring for the character in question. Since we have no fertility and hatchability records for the flock as a whole, it is impossible to mathematically measure the effect of such selection on our flock.

Pearl ('09) reports a correlation coefficient of only $.031 \pm .072$ between mothers and daughters in hatchability, but only 87 individuals were studied. Dunn ('23) states that he was unable to separate high and low hatching lines by two generations of selection. He did find, however, that families tend to become different in hatching power and to retain this difference.

Table 5 clearly indicates that hatching power is transmitted from mother to daughter, even though rigid control of the many environmental factors that modify the hatching power is very difficult. These varying conditions often obscure the true hatching ability of the pullet as an individual. The use of breeding females of high hatching power is the first step toward improving the flock in this particular characteristic. We have shown in section 3 that the hatching power of a pullet is sensibly correlated with her later hatching power. Follow this by using breeding hens that transmit high hatchability to all of their daughters. The male's part in heredity of hatchability will next be considered.

PART II.

The Male's Rôle in Inheritance of Fertility and Hatchability.

Section 6. The Constancy of Fertility in Males.

In studying the question of the inheritance of fertility and hatchability, much importance should be attached to the male side of the flock, for the male is more than half the flock from a genetic standpoint because each male furnishes half the inheritance to the progeny of several hens.

The measure of the male's fertilizing ability is the mean degree of fertility from his different matings. The accuracy of such a measure will of course depend upon whether or not high fertility is governed in inheritance by dominant or recessive factors, or whether it is independent of Mendelian factors. If high fertility depends upon recessive factors, we should expect less variation in the daughters from a hen that carries these factors pure, so that she herself is genetically highly fertile, than would be the case if high fertility is dependent on dominant factors and these were not in homozygous condition. The fact that manifestation of fertility in the eggs is probably dependent on both male and female makes the classification of either males or females with regard to this characteristic a hazardous undertaking. A careful analysis of the results from mating specific males to a number of females in successive years with conditions kept uniform would help much to explain this confusing problem.

The problem of the constancy of a male's ability to transmit a certain degree of fertility to his daughters may be elucidated by correlating the fertility of his daughters sired during his first breeding year with that of his daughters sired during the second breeding year, using pullet records in all cases. In other words, if males transmit a certain degree of fertility to their daughters in successive years, a positive correlation will exist. Such a tabulation is made from data available in table 6. Unfortunately, records on only 51 pairs of daughters are obtainable for study. The number is small because few males are used as breeders after their cockerel year.

TABLE 6. — *Correlation in Fertility between Males' First and Second-Year Daughters.*

Fertility of Males' First Year Daughters, Per Cent.	Fertility of Males' Second Year Daughters, Per Cent.																				
	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	f.
0–4	2											1					1		1		5
5–9											1									1	2
10–14																					
15–19																			1		1
20–24																	1		1		2
25–29																		1			1
30–34																					
35–39																					
40–44															1					1	2
45–49																				1	1
50–54																					
55–59																				1	1
60–64			1																		1
65–69															1	1					2
70–74																	1			2	3
75–79								1		1			1							2	5
80–84											1					1				4	6
85–89																				2	2
90–94											1							1	1	1	4
95–100					1			1			1			1	1				3	5	13
f.	2	0	1	0	1	0	0	2	0	1	4	1	1	1	3	2	3	2	7	20	51

Constants calculated from Table 6.

First-year daughters' mean fertility	$.6651 \pm .031064$
First-year daughters' standard deviation	$.3289 \pm .021966$
Second-year daughters' mean fertility	$.7700 \pm .025001$
Second-year daughters' standard deviation . . .	$.2647 \pm .017678$
Coefficient of correlation	$.2151 \pm .090076$

In table 6 the mean fertility of the first-year daughters was .6651 while the mean for the second-year daughters was .77. There is a difference of $.1049 \pm .0399$, which, judged by the magnitude of its probable error, is of doubtful significance. There is also no sensible difference in the standard deviation of first-and second-year daughters. A sensible degree of correlation between first-and second-year daughters is questionable because $r = .2151 \pm .090076$. The probable error is almost half as great as the coefficient itself. The only logical interpretation that can be placed on the limited data in table 6 is that mean fertility in the daughters of the same group of males in successive years is strikingly constant, and in the second place that a positive correlation coefficient of questionable magnitude exists between first-and second-year daughters in fertility. More data of a similar nature are required to clear up this question.

Section 7. The Constancy of Hatchability in Males.

The male's ability to transmit fertility is still questionable, as has been pointed out in section 6. In the present section the subject of the constancy of hatchability in the male, as measured through his daughters, will be considered. The same difficulties are encountered in studying this question that have already been men-

tioned for fertility. Possibly environmental factors are of less importance in hatchability than in fertility. Pearl ('09) believes that hatching quality is more of an innate constitutional character than is fertility. If hatching quality is dependent upon Mendelian factors in inheritance, the degree of correlation between hatchability of the eggs of first-year daughters and the eggs of second-year daughters would vary with the number of factors concerned, and with the degree of homozygosity in the males for these factors. Should there be a sensible positive correlation, it would indicate that the male as well as the female transmits hatching power to the offspring.

In table 7, the group of 51 pairs of daughters studied in section 6 is tabulated for hatchability.

TABLE 7.— *Correlation in Hatchability between Males' First and Second-Year Daughters.*

Hatchability of Males' First Year Daughters, Per Cent.	Hatchability of Males' Second Year Daughters, Per Cent.																				f.
	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	
0–4	6		1	2	1			1				2	2		3			1	1		20
5–9																					
10–14		1																			1
15–19							1														1
20–24	1																				1
25–29	1														1		1				3
30–34	1						1				1		1		1						5
35–39									1												1
40–44									1		1										2
45–49	1																	1			2
50–54	1														1		1	1			4
55–59	2																		1		3
60–64												1				1					2
65–69																1	1				2
70–74																					
75–79															1					1	2
80–84																					
85–89					1										1						2
90–94																					
95–100																					
f.	13	1	1	2	2	0	2	1	2	0	2	3	3	0	8	2	3	3	2	1	51

Constants calculated from Table 7.

First-year daughters' mean hatchability	$.2965 \pm .025445$
First-year daughters' standard deviation	$.2694 \pm .017992$
Second-year daughters' mean hatchability	$.4484 \pm .031130$
Second-year daughters' standard deviation	$.3296 \pm .022913$
Coefficient of correlation	$.2996 \pm .085972$

Referring to table 7, the mean hatchability of first-year daughters is.2965, while the second-year daughters of the same male have a mean of .4484. The difference is $.1519 \pm .0336$, which is a significant difference. The second-year daughters appear to be superior to the first-year daughters in hatching power. To draw any conclusion, however, on such meager data would be more than hazardous. The standard deviation does not differ significantly in the two groups of daughters.

A sensible positive correlation of .2996±.085972 appears between first-year pullet daughters and second-year pullet daughters in hatchability. Table 7 thus furnishes a very small amount of evidence that hatching power is transmitted through the male, and that it is a more constant character than would be possible were it independent of heredity.

Section 8. Relation between the Fertility of the Sire's Dam and His Phenotypical Fertilizing Ability.

As there is no direct measure of a sire's phenotypical fertilizing power, it is necessary to resort to the indirect, which is the average fertility of his mates. The degree of fertility in the sire's dam may be something of a guide to his inheritance. The pertinent question at this point is: Is the degree of fertility of a cockerel's mother a guide to his ability to fertilize the eggs of his mates? If such be the case, there should be a sensible positive correlation between sire's dam's fertility and his mates' fertility. In table 8 the dams of cockerels used throughout the eleven-year period have been tabulated with the mates of these cockerels. The record of any particular dam was used against each of the mates of her son. The total number of mates was 647.

TABLE 8. — *Correlation in Fertility Between Sires' Dams and Sires' Mates.*

Sires' Dams' Fertility, Per Cent.	Sires' Mates' Fertility, Per Cent. 0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	f.
0–4																					
5–9																		1	2	1	4
10–14																					
15–19																					
20–24				1											1	1		3	3	2	11
25–29																					
30–34																					
35–39												1	1		1			1		9	13
40–44																					
45–49																					
50–54																					
55–59															1	1	1	2	1	12	18
60–64							1	2		1	1	1	2	1	3		7	5	4	15	43
65–69						1			1	2		1	1	7	4	4	4	2	7	15	49
70–74						1	1		1					2	2	2	3	4	14	21	51
75–79					1					1				2		1		2	2	6	15
80–84			2		2		3	3	2	1	5		5	5	10	6	9	11	23	48	135
85–89									1						1	1		2	3	18	26
90–94						1		2	1	1		4	2	1	3	2	5	10	15	46	93
95–100				1			1	2	3	3	1	1	6	5	4	9	14	14	26	99	189
f.			2	2	3	3	6	9	9	9	7	8	17	23	30	27	43	57	100	292	647

Constants calculated from Table 8.

Sires' dams' mean fertility	.8157±.004492
Sires' dams' standard deviation.	.1694±.003176
Sires' mates' mean fertility.	.8531±.004587
Sires' mates' standard deviation	.1730±.003244
Coefficient of correlation	−.1890±.025363

The mean fertility of the sires' mates is .0374±.00642 greater than the mean of the sires' dams. This is a small but significant difference and indicates that more attention was given to fertility from the female standpoint than from the male standpoint. The standard deviation is almost identical for both groups of females. A negative coefficient of correlation of .1890±.025363 appears rather difficult to explain. It certainly does indicate that the degree of fertility shown by sire's mother is not an index to the degree of fertility that such a sire will exhibit in his mates — his phenotypical fertilizing ability. This negative correlation may be due to selection of females to be used as breeders with more regard to high fertility in ancestry than is practised in selecting male breeders; or possibly males from the very fertile ancestry were mated to pullets that were lacking in fertility but otherwise desirable.

Section 9. Relation between the Hatchability of the Sire's Dam and His Phenotypical Hatching Ability.

The question of hatchability may be considered by the same methods used in section 8 in studying fertility. The identical group of birds is again tabulated for hatchability in table 9.

TABLE 9. — *Correlation in Hatchability between Sires' Dams and Sires' Mates.*

Sires' Dams' Hatchability, Per Cent.	Sires' Mates' Hatchability, Per Cent. 0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	f.
0–4													1	1					1	1	4
5–9																					
10–14																					
15–19					1							1			2	1					5
20–24																					
25–29									1		1		1	2	1	2		2			10
30–34		1			1		1		4	3	4	2	4	3	1	1		1		1	27
35–39										1	1		1				1		1		5
40–44									1	4	1	1	2	1		2	2				14
45–49				1	1	1	3	3	2	3	2	4	2	4	3	2	1	3			35
50–54						2	1		4	1	3	4	4	4	4	2	2	1	2		34
55–59						1	3	3	1	1	5	2	7	5		3	3	3	2	2	41
60–64				1		1		2	3	4	6	3	8	4	5	10	5	2	3	2	59
65–69				1		2	2	1	2	2	2	1	2	2	7	6	3			2	35
70–74	1	1	1		1	2	4	6	4	3	4	7	6	7	8	9	7	6	2	8	87
75–79				1	2	1	2	1	1	3	4	2	10	9	7	11	3	4	2	3	66
80–84		2	1		2		1	1	1	1	8	7	5	6	6	6	7	10	9	1	74
85–89				1	1	2	1	3		3	3	3	5	7	7	6	2	3	1	1	49
90–94				1			1		1				3	2	6	8	4	5	5	1	37
95–100				1		2	2		2	1	2	1	6	10	4	8	8	9	6	3	65
f.	1	4	2	7	9	14	21	20	27	30	46	38	67	67	61	77	48	49	34	25	647

Constants calculated from Table 9.

Sires' dams' mean hatchability	.6977±.005115
Sires' dams' standard deviation	.1929±.003617
Sires' mates' mean hatchability	.6488±.005229
Sires' mates' standard deviation	.1972±.003698
Coefficient of correlation	.1579±.025856

The average hatching ability of the sires' dams is $.6977 \pm .005115$, while that of the sires' mates is $.6488 \pm .005229$. There is a difference of $.0489 \pm .007314$, which means that the males used as breeders came from dams of higher hatching power than was inherent in the pullets to which they were mated. The almost identical standard deviation for the two groups points to a similar variability in hatching power for the two.

The coefficient of correlation between the sires' mothers and their mates is .1579 $\pm .025856$, a small but sensible correlation. Possibly this can be interpreted as meaning that males tend to show a phenotypical hatching power comparable with that of their dams. In selecting cockerels for breeders, hatching power of their dams is something of a guide to their ability to contribute hatching power to the eggs they fertilize. There is considerable probability that the male does influence the hatching power of his mates' eggs.

Section 10. Relation of Sire's Average to his Daughters' Individual Fertility.

In considering the fertilizing and hatching power of males, it is necessary to use some measure of their phenotypical character. This fact has been pointed out by Pearl ('09) and, as he states, the average fertility and hatching power of hens mated to a male may be used as his index. In table 10 the average fertility of each sire from his different mates is tabulated against the fertility of each of his daughters. This average figure for each sire is thus inserted a number of times to correspond with the number of his daughters that were used as breeders.

TABLE 10. — *Correlation in Fertility Between Sires' Mates and Sires' Daughters.*

Sires' Mates' Fertility, Per Cent.	Sires' Daughters' Fertility, Per Cent.																				f.
	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	
0–4																					
5–9																					
10–14																					
15–19																					
20–24																					
25–29																					
30–34																					
35–39																					
40–44																					
45–49																		1			1
50–54																					
55–59											1	1		2	1		2		2	4	13
60–64																			1		1
65–69								1							1		2	4	6	3	17
70–74								1	1		1		1	1			1	1	1	11	19
75–79					1		1	1		1			1		2	4	1	5	2	14	33
80–84				1							1	1	2	3	4	3	5	4	11	11	46
85–89						1				2	1	1			5	2	8	4	8	22	54
90–94						1		1	3	1	1		5		4	3	3	10	12	34	78
95–100				1	1	1		2	2	1	1	2	4	13	8	5	13	17	21	58	150
f.				2	2	3	1	6	6	5	6	5	13	19	25	17	35	46	64	157	412

Constants calculated from Table 10.

Sires' fertility mean	.8761±.003522
Sires' fertility standard deviation	.1060±.002491
Sires' daughters' mean fertility	.8416±.005599
Sires' daughters' standard deviation	.1685±.003959
Coefficient of correlation	.0244±.033211

A difference, amounting to .0345±.006614, will be observed between the sires' mean fertility and their daughters' mean fertility. This significant difference is easily explained if the same factors are operating to affect fertility of males and females. A wider range of variability in the daughters as compared with their sires, measured by the standard deviation, seems to indicate that there is little or no constancy in fertility between father and daughter.

No sensible correlation in fertility exists between sire and daughters as table 10 shows. In the face of this fact, there is no evidence that factors for fertility are transmitted from sire to daughter. In other words, fertility does not seem to be an inherited trait that is transmitted from parent to offspring, as has already been shown in both tables 4 and 10.

Section 11. Relation of Sire's Average to Daughters' Individual Hatchability.

The same group of birds used in table 10 is correlated in table 11 to study the relationship between sire and daughters in hatching power.

TABLE 11.—*Correlation in Hatchability between Sires' Mates and Sires' Daughters.*

Sires' Mates' Hatchability, Per Cent.	Sires' Daughters' Hatchability, Per Cent.																				f.
	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	
0–4																					
5–9																					
10–14																					
15–19																					
20–24																					
25–29									1		2										3
30–34																					
35–39																					
40–44								1		1		1				2					5
45–49			1							2	3	1				2	1	2			12
50–54								4	4	1	2	5	4	8	2	4	1	2	2	2	41
55–59							1	1	1	1		6	10	1	5	3	3	4	3	1	40
60–64				2	3	1	3	2	1	4	5	1	6	6	8	6	4	5	2	3	62
65–69				2		2	1	3	2	2	2	3	5	2	5	9	4	3	1	2	48
70–74					1	2	3	1	2	2	5	5	10	10	8	10	3	8	8	4	82
75–79						1	1	2	1	2			2	1	2	5	4	2	3		26
80–84	1						1				6	1	7	10	4	11	8	4	4	3	60
85–89														1	2	2	3	2	4	1	15
90–94										1			2		5	3	2	2	2	1	18
95–100																					
f.	1		1	4	4	6	10	14	12	16	25	23	46	39	41	57	33	34	29	17	412

Constants calculated from Table 11.

Sires' hatchability mean	$.6824 \pm .004084$
Sires' hatchability standard deviation	$.1229 \pm .002888$
Sires' daughters' mean hatchability	$.6753 \pm .006217$
Sires' daughters' standard deviation	$.1868 \pm .004396$
Coefficient of correlation	$.2268 \pm .031523$

The mean hatchability of the sires is almost identical with that of the daughters. This is in striking contrast to the mean of dams and daughters given in table 5 where the figures are $.7064 \pm .003891$ and $.5091 \pm .003740$, respectively. Such evidence might be interpreted as showing that a closer relationship exists between sires and daughters than between dams and daughters in hatching power. Such a relationship is probably due entirely to the somewhat dissimilar methods for measuring hatching power in sire and dam. The range of variability is greater in daughters than in sires evidently because of the variable nature of the males mated to these daughters.

The coefficient of correlation between sires and daughters is $.2268 \pm .031523$. Comparing this factor with the factor calculated from table 5 where mothers and daughters are concerned, the two are found to be of almost identical magnitude when their probable errors are considered. Table 11 furnishes convincing evidence of the heritability of hatching power. In this instance, hatching power of sires is carried on in their daughters. Table 11 further points to the necessity of using tested males in developing a flock carrying uniformly high hatching power.

Section 12. Relation of Sire's Dam to his Daughters' Fertility.

In section 8 the relation between sire's dam and his phenotypical fertilizing ability has been considered. A negative relationship was found to exist in that case. The present section is an attempt to discover if the sire transmits to his daughters a degree of fertility similar to that of his dam, so that when these daughters are mated with other males their probable fertility may be forecasted. In table 12, 748 pullet fertility records are tabulated with the fertility records of their sire's mother as a pullet.

TABLE 12.—*Correlation in Fertility between Sires' Dams and Sires' Daughters.*

Sires' Dams' Fertility, Per Cent.	Sires' Daughters' Fertility, Per Cent.																				f.
	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	
0–4																					
5–9															1		1	1	1		4
10–14																					
15–19																					
20–24	1										1		1	1			1	2	1	3	11
25–29																					
30–34																					
35–39													1			2			1	3	7
40–44																					
45–49																					
50–54																					
55–59	1										2				1	1	1	2	4	5	17
60–64	2	1			4	1	1	1	1		1		2	5	4	4	2	1	3	17	50
65–69	1			1	2	3		2		2	2			1	4	4	6	5	6	28	67
70–74	5				1	2		4	2	2	2	2	1	7	4	2	7	3	7	21	72
75–79		1					1				1					1	1	3	1	9	18
80–84	15	2	1	2	1			3	1	1	3	2	4	6	6	9	5	9	27	52	149
85–89	1				1				1	1		1	1	1	1	3	3	4	4	7	29
90–94	14	1	1			1	3		2	3	6	3	4	5	7	5	10	16	14	29	124
95–100	12		1	3	5	1	3	4	6	5	4	4	9	7	12	8	13	27	19	57	200
f.	52	5	3	6	14	8	8	14	13	14	22	12	23	33	40	39	50	73	88	231	748

Constants calculated from Table 12.

Sires' Dams' Mean Fertility	$.8183 \pm .003909$
Sires' Dams' Standard Deviation	$.1585 \pm .002764$
Sires' Daughters' Mean Fertility	$.7364 \pm .007108$
Sires' Daughters' Standard Deviation	$.2882 \pm .005026$
Coefficient of Correlation	$-.0501 \pm .024599$

The mean fertility of the dams of the males used in this study is $.0819 \pm .008112$ greater than the mean for the daughters of these males. The males used, therefore, came from dams of high fertility but the daughters of these males failed to measure up to such a standard. The standard deviation of the daughters is almost twice as great as for the sires' dams, showing that the daughters are a highly variable lot. The coefficient of correlation is negative but insignificant because of the magnitude of its probable error. The conclusion seems justified, therefore, that the degree of fertility of a sire's dam is no index to the degree of fertility that his daughters will exhibit.

Section 13. Relation of Sire's Dam to his Daughters' Hatchability.

If the hatching power of a sire's dam is something of an index to his probable inheritance of factors affecting hatchability, such relationship will appear when the hatchability records of the daughters are tabulated with the records from the sires' dams. Table 13 is thus made up of the same birds used in table 12.

TABLE 13.—*Correlation in Hatchability between Sires' Dams and Sires' Daughters.*

Sires' Dams' Hatchability, Per Cent.	Sires' Daughters' Hatchability, Per Cent. 0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	f.
0–4																					
5–9																					
10–14																					
15–19				1			1				1		2			1				1	7
20–24																					
25–29	2							1	1	1		1	1	1		1		2			11
30–34	3	3	1		2	2	2	2	1		2	1	4	1	1	3	1		1	1	31
35–39		1					1	1		1			1								5
40–44	6	1	1		2		1	1	2	2	1	2	2	3		3	2				29
45–49	16	2	4	2	2	1		1	1	2	2	4			1	1		3		1	43
50–54	2			1	2	1	3		4		2	1	3	1	1	1	2	2	2	2	30
55–59	6			1	2		1	2	1	1	3	1	1	8	2	3	2	2	3	3	42
60–64	12			1	1	3	1	1		3	3	3	10	3	6	11	6	5		3	72
65–69	1						1						1		2	1	4				10
70–74	13	2	1	1	4	3	5	6	7	2	4	8	10	12	7	11	4	12	8	2	122
75–79	12		1	3	2	3	1	3		1	4	3	6	6	7	9	8	2	4	3	78
80–84	18	2	2	2		2	5	5	3	5	3	5	14	8	9	7	7	3	6	9	115
85–89	7		1		2	1	1				3		4	4	2	1	1			2	29
90–94	2					3	1	3	2	1	1	1	2	3	2	4	4	4	1	4	38
95–100	26	1	1	4		2	4	1	1	4	3	5	5	2	5	9	3	1	7	2	86
f.	126	12	12	16	19	21	28	27	23	23	32	35	66	52	45	66	44	36	32	33	748

Constants calculated from Table 13.

Sires' Dams' Mean Hatchability	$.7019 \pm .004664$
Sires' Dams' Standard Deviation	$.1891 \pm .003298$
Sires' Daughters' Mean Hatchability	$.5096 \pm .007588$
Sires' Daughters' Standard Deviation	$.3077 \pm .005366$
Coefficient of Correlation	$.0588 \pm .024576$

The mean hatching power of the hens whose sons were used for breeding was .7019. The daughters of this group of males averaged only .5096 of fertile eggs hatched. This difference in the means amounts to $.1923 \pm .008906$ and is a much more striking difference than was observed between the same group of females in fertility. The standard deviation of the two groups agrees with that found for fertility in table 12. Again the daughters of the males show almost double the range in variability of their sires' dams.

The coefficient of correlation is here positive, but of no significance since it is a little more than twice its probable error. The lack of correlation between sire's dam and sire's daughters in hatchability can scarcely be interpreted to show that hatchability is not governed by factors transmitted from sire to daughter. The hatching power of a cockerel's dam is only the phenotypical manifestation of her ability and may be affected by her mate as well as by numerous environmental factors. She furnishes, moreover, but a part of the heritage of her son. If several factors governing hatchability are transmitted equally by males and females and if both parents have an influence on the hatching power of eggs laid and fertilized, respectively, this apparent independence of hatching power in inheritance will be explained.

If fertility be governed by genes transmitted in Mendelian fashion and without sex-linkage, this fact should be brought out by correlating the sire's record with his son's record. The only measure is the fertility record of the eggs laid by females mated to such males. If it were possible to compare males by a system of mating to the same group of females, the variable factors could be reduced to the male side alone. Such a system seems impossible to attain because of numerous factors too well understood to require mention.

Section 14. Relation of Sire and Son in Fertility.

TABLE 14.—*Correlation in Fertility between Sires and Sons.*

Sires' Fertility, Per Cent.	Sons' Fertility, Per Cent. 0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	f.
0–4																					
5–9																					
10–14																					
15–19																					
20–24																					
25–29																					
30–34																					
35–39														1		2					3
40–44																		1			1
45–49					1															2	3
50–54																					
55–59																	1			1	2
60–64																				1	1
65–69										1				1	1					3	6
70–74								1								1	4	1	3	4	14
75–79																		1	2	4	7
80–84						1					1		1		1		3	3	3	6	19
85–89								1							2	1	2	2	2	5	15
90–94								1	1				1	2	2	1	2	3	3	9	25
95–100								1	3	2		1	2	3	3	3	6	6	12	32	74
f.					1	1		4	4	3	1	1	4	7	9	8	18	17	25	67	170

Constants calculated from Table 14.

Sires' Mean Fertility	$.8682 \pm .007041$
Sires' Standard Deviation	$.1361 \pm .004979$
Sons' Mean Fertility	$.8441 \pm .008660$
Sons' Standard Deviation	$.1674 \pm .006124$
Coefficient of Correlation	$.0685 \pm .051486$

In table 14 each pullet mate of a sire is paired with a pullet mate of his son. The number of pairs concerned is 170 and the number of sires included is about the same as the number of sons included. The mean fertility of the sires and their sons is not significantly different, and the range in variability of sires and sons, as measured by the standard deviation, is about the same. The coefficient of correlation is very small and its probable error renders it negligible. The only conclusion that may be drawn from this small amount of data is that either the fertility record of a male's mates is not a reliable index to his inherent fertilizing ability, or else degree of fertility is not transmitted from sire to son.

In the next section the relation of hatchability of sire and son will be considered for the same birds that were used in studying fertility.

Section 15. Relation of Sire and Son in Hatchability.

TABLE 15. — *Correlation in Hatchability Between Sires and Sons.*

Sires' Hatchability, Per Cent.	Sons' Hatchability, Per Cent.																				f.
	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–100	
0–4																					
5–9																					
10–14																					
15–19											1										1
20–24																1					1
25–29							1		1							1	1			1	5
30–34												1	1								2
35–39					1		1	1			1		1	1			1				7
40–44					1					3	1			1	2	1		1			10
45–49							2				1	2	1	2	1	1					10
50–54								1			1	1	2	1	1			1	1		9
55–59							1	1	1		1	1	4	4	1					2	16
60–64										1	3		1	1	3	2	1		1	1	14
65–69					1								1	1	2	4	1	2	1		13
70–74									2	1	1		1	1	1	1		1		1	10
75–79				1						1		1	3	3		4	1	2	1	1	18
80–84						1		1		1	1	2	3		1		1	1		1	13
85–89									1	2	2		3	1	3	1		1			14
90–94				1				1			1			2	2	3	1	1			12
95–100				2		1		1			1		1	1	2	2	1	1	1	1	15
f.				4	3	2	5	6	5	9	15	8	22	19	19	21	8	11	5	8	170

Constants calculated from Table 15.

Sires' Mean Hatchability	$.6738 \pm .010274$
Sires' Standard Deviation	$.1986 \pm .007265$
Sons' Mean Hatchability	$.6418 \pm .009720$
Sons' Standard Deviation	$.1879 \pm .006873$
Coefficient of Correlation	$.0755 \pm .051440$

Reference to table 15 shows that the mean degree of hatchability is almost the same in sires and sons. The two groups are also closely similar in standard deviation. There is no sensible correlation between father and son in hatchability. The degree of correlation here is practically the same as that observed for fertility in table 14. If we are using the correct measure for a male's hatchability, there is no evidence in these data to show that hatching power is transmitted from sire to son.

Section 16. Mendelian Interpretation of the Inheritance of Fertility and Hatchability.

Before entering upon a discussion of the possibilities of Mendelian inheritance of factors governing fertility and hatchability, it would seem desirable to present the mean records in the flock from year to year. These means are given below in table 16 along with the number of birds tested each year.

TABLE 16. — *Mean Fertility and Hatchability Records from the Massachusetts Agricultural Experiment Station Flock.*

YEAR.	Average Fertility.	Average Hatchability.	Number of Birds.
1913	.7562± .016855	.5910± .016578	73
1914	.8300± .015294	.5793± .016514	67
1915	.8308± .012692	.5613± .013015	118
1916	.8834± .010973	.6469± .015942	62
1917	.9158± .009776	.6217± .014709	78
1918	.8821± .009917	.6502± .013599	89
1919	.8882± .014611	.6941± .014602	56
1920	.8647± .014243	.6861± .017473	51
1921	.9107± .012241	.7483± .014129	59
1922	.8746± .010910	.7449± .011125	89
1923	.7749± .011944	.7051± .011399	144

The fertility mean has fluctuated appreciably from year to year and has not increased during the past six years. The low fertility of 1923 can be attributed to no other cause than adverse weather conditions throughout the winter and spring months. The majority of the males seem to have suffered from more or less frosting of combs and wattles during the winter of 1922–23. The basis of selecting breeding males for 1923 was not voluntarily changed from that of previous years. The general deduction must therefore be made, as Pearl ('09) has done, that fertility is dependent largely upon environmental factors and that it is not an inherent characteristic that is transmitted in inheritance.

Table 16 indicates an increase of .1141±.0206 in mean hatchability from 1913 to 1923. This increase is mathematically significant. There has been a gradual upward trend in mean hatching power since 1915. This increase has accompanied the use of breeding pullets and breeding cockerels from mothers showing good hatching power. The .04 drop in hatchability in 1923 is within the range of probability and need not be considered.

RELATION OF MALE TO THE HATCHING POWER OF HIS MATES' EGGS.

Unmistakable evidence is available to show that the male contributes to the hatching power of his mates' eggs. For want of any more suitable term we have used "male's phenotypical hatching power" to express the male's part. In table 9 a positive correlation coefficient of .1579±.025856 was observed between the sire's dam, and his phenotypical hatching power. A sensible correlation could not exist unless the male contributes to the hatching power of his mates' eggs.

The most conclusive evidence that the male influences the hatching power of his mates' eggs lies in the fact that the same hen shows different hatching power when mated to different males in successive years or even in the same year. Such data should be placed beside data showing the degree of constancy of hens in hatchability when mated to the same male on successive years. No data are available on the last-named question from our flock, although table 3 brings out a degree of correlation between first and second year hatchability in hens, amounting to .4346±.034409. The correlation should be much greater if the male did not play a part. In section 5 a sensible correlation between mothers and daughters was discovered. Reference to the constants calculated from table 5 shows that the hatching power of a hen is an uncertain guide to the probable hatching power of her daughters. The relative magnitude of the standard deviation of dams and daughters indicates that the phenotypical hatching power of a hen is an uncertain index of her true genetic constitution. This fact would seem to indicate that the male obscures the true genotype of the hen.

Data from the flock of the Massachusetts Agricultural Experiment Station on the constancy of hatching power in males is very limited. In table 17 a comparison is made between the first-year hatching power and second-year hatching power of

15 males. The figure used for each male represents the mean for all of his mates. These males were used on the following years: — 2 in 1913 and 1914, 4 in 1914 and 1915, 2 in 1915 and 1916, 2 in 1916 and 1917, 1 in 1917 and 1918, 2 in 1919 and 1920, 2 in 1922 and 1923.

TABLE 17. — *Mean Hatchability of Males.*

MALE NO.	First Year.	Second Year.
A323	57.00	55.80
A324	59.19	57.93
68	38.67	52.17
228	59.50	67.75
619	59.00	49.75
A271	70.71	67.40
A274	50.23	63.50
3617	53.93	64.40
5470	62.00	70.75
5581	59.29	65.00
8528	71.83	72.62
B2776	67.00	75.00
B2828	64.13	85.50
C901	76.20	65.00
C938	70.57	74.44

Mean first year, $.6128 \pm .016043$; Mean second year, $.6580 \pm .015825$; Difference in means, $.0452 \pm .0225$.

Although the data are meager in table 17, we can give it no other interpretation than as indicating that the male does partly control the hatching power of his mate through dominant factors.

The mean hatchability for the fifteen males during the first year is $.6128 \pm .016043$, for the second year $.6580 \pm .015825$. There is a difference of $.0452 \pm .0225$. This difference is just double its probable error and can therefore be of no consequence. The point we wish to emphasize in table 17 is the striking constancy in phenotypical hatching power of the same male, even when mated to different hens on two successive years. Such a degree of constancy was not found to exist in hens, as table 3 shows. The mean pullet-year hatching power of the hens was $.5678 \pm .011313$. The mean second-year hatching record of the same hens was $.4791 \pm .012963$. The standard deviation is nearly three times as great for the hens as for the males. The difference in the mean hatching power for the same hens on two successive years is $.0887 \pm .0172$, which is significant. The genetic interpretation given below will serve to elucidate several apparent complications.

Genetic Factors Concerned[1]

One dominant gene seems to be concerned in the production of high hatchability. We use the symbol H to designate this gene. There is no sex linkage and all results obtained are to be expected in a simple mono-hybrid ratio. With this hypothesis, three possible genotypes of males and females exist, namely, HH, Hh, and hh individuals. The genotype is obscured in most cases for both males and females. Such being the case, only the breeding test can be used as a guide for matings.

Hatching records on 886 females studied in this report show that these birds divide themselves into three general classes or phenotypes: — (1) Those showing hatchability of 85 per cent or above, we call high. (2) Those with a hatchability of 55 to 84 per cent, we call medium. (3) Those below 55 per cent, we call low. Since factor H has a cumulative effect, the range for the medium class is twice as great as for the high class. The minimum for the low class has not yet been determined. Below are summarized the males' phenotypical and genotypical classes:

[1] A detailed report on the genetics of hatchability will appear in another publication.

Males' Phenotypical Character.

HH males on HH hens give all high hatchability.
HH males on Hh hens give all medium hatchability.
HH males on hh hens give all medium hatchability.
Hh males on HH hens give all high hatchability.
Hh males on Hh hens give all medium hatchability.
Hh males on hh hens give all low hatchability.
hh males on HH hens give all medium hatchability.
hh males on Hh hens give all low hatchability.
hh males on hh hens give all low hatchability.

Males' Genotypical Character.

HH males on HH hens give all HH daughters.
HH males on Hh hens give 50% HH and 50% Hh daughters.
HH males on hh hens give all Hh daughters.
Hh males on HH hens give 50% HH and 50% Hh daughters.
Hh males on Hh hens give 25% HH, 50% Hh, and 25% hh daughters.
Hh males on hh hens give 50% Hh and 50% hh daughters.
hh males on HH hens give all Hh daughters.
hh males on Hh hens give 50% Hh and 50% hh daughters.
hh males on hh hens give all hh daughters.

Both parents must carry the H factor in order to be phenotypically good hatchers. Hens cannot rank in the first class unless they carry the gene H in homozygous condition and are mated to H-bearing males. These observations indicate a cumulative value for the factor H and show why the male by failure to contribute at least one-half H-bearing sperm ranks a genotypically high hen as a medium hatcher. Furthermore, both HH and Hh males probably give about the same hatching record from HH hens. The progeny test alone can give a clue to the genetic composition of males if pullets of unknown formulæ are used as breeders.

Selection for high and low hatchability did not give results in two generations according to Dunn ('23). The probable explanation is that he used in his low line genotypically high (HH) hens that gave medium hatching records because they were mated to hh males. If such were the case, no appreciable separation could take place in but two generations. There may also have been a lack of HH or Hh males in his high line. Selection for high hatchability with the female as a guide and using cockerels from hens that hatched well has been a slow but progressive process in our flock, as already shown in table 17. In table 9, the mean hatchability of the dams of the males used for breeders is about 70 per cent. This would indicate that, on the average, the breeding males came from Hh hens. Thus, only in the later years of the period could any considerable percentage of males have been of the formula Hh. A study of earlier records shows that practically all the males must have been of hh composition, because they came from medium or low-hatching dams.

SUMMARY.

1. No correlation was found between fertility and hatchability in 758 pullets.
2. Fertility in the hen behaves as an individual characteristic with a fair degree of constancy from year to year.
3. Fertility does not appear to be transmitted from mother to daughter.
4. Hatching power is more constant from year to year in the same hen than is fertility.
5. Hatching power gives evidence of being transmitted from mother to daughter.
6. Fertility in the male behaves as an individual characteristic and probably with some constancy in the same individual from year to year.
7. The fertility record of a hen is no index to the fertilizing ability of her sons.
8. Fertility does not appear to be transmitted from sire to daughter.
9. Hatchability is more constant from year to year in the same male than is fertility.
10. Fertility does not appear to be transmitted from sire to son.
11. The hatching power of a male cannot be judged by his dam's hatching record.

12. Hatching power gives evidence of being transmitted from sire to daughter.

13. Insufficient data are available on the transmission of hatching power from sire to son.

14. Fertility is evidently not an inherited characteristic.

15. Hatchability is evidently an inherited trait. High hatchability is dependent in inheritance upon one dominant gene. Both male and female parent govern the hatching record, thus obscuring the true genetic composition of either parent.

16. Genetically pure hens for high hatchability may be discovered through their own hatching record. Genetically pure males for high hatchability can be distinguished from males heterozygous for the factor only by the progeny test combined with mating tests. Both the mating and the progeny test should be used for choosing males to improve the flock in hatchability.

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AGRICULTURAL EXPERIMENT STATION

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COMBATING APPLE SCAB

Spraying and Dusting Experiments in 1923 with Summary of Three Years' Results

By WILLIAM L. DORAN and A. VINCENT OSMUN

Recently completed studies on apple scab and its control show that development of this disease may be prevented through the use of a number of different materials — lime-sulfur, dry lime-sulfur, or copper sprays followed by lime-sulfur, may be effectively used, as also dusts of various kinds. Scab development is governed largely by weather conditions; possibility of successful control, by the proper timing of protective treatment and efficiency in the actual spraying and dusting work. These facts are brought out in this bulletin, which is the final report of a three-year investigation. Tabulated results of the work carried on in 1923 are presented, likewise a summarization of all data collected during the course of the study.

Publication of this Document approved by the Commission on Administration and Finance

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AGRICULTURAL EXPERIMENT STATION

AMHERST, MASS.

COMBATING APPLE SCAB.

SPRAYING AND DUSTING EXPERIMENTS IN 1923[1] WITH SUMMARY OF THREE YEARS' RESULTS.

By William L. Doran and A. Vincent Osmun.

Introduction.

Scab has long been a disease to reckon with in the apple orchards of Massachusetts, but not until the advent and extensive planting of the McIntosh, a variety particularly susceptible to attack by the scab fungus, did it become a menace of large proportions. As more and more of the McIntosh orchards came into bearing, an increasing number of growers experienced difficulty in controlling the disease and losses became so large as to seriously threaten the orchard industry. Finally, in 1920, appeal was made to the Station by the growers, and in the fall of that year the Station entered into a cooperative agreement with the Nashoba Fruit Producers' Association under which experiments on the control of scab were planned and undertaken by the Department of Botany.

The results of the spraying and dusting experiments of the first two seasons already have been reported by Krout (1) (2).[2] The present report is on the work of 1923, together with such references to the work in Massachusetts in 1922 and 1921 as will assist in making points clear. The results of the three years' experiments are summarized in Table III (page 17). Other references in this report are for the most part to spraying and dusting experiments conducted within the last two years, especially in the northeastern states.

The general objectives of the investigations in 1923 were to secure more light on the following questions in regard to the control of apple scab:

1. What is the effect of the addition to the spray schedule of a prepink application?
2. How does dry lime-sulfur compare with liquid lime-sulfur in fungicidal efficiency?
3. What is the ratio of dry lime-sulfur to water, at which this fungicide is dependable?
4. What is the effect of the addition of calcium caseinate spreader to the fungicide when applied as a dust and as a spray?
5. How does a spray schedule consisting of lime-sulfur throughout the season compare with a schedule in which Bordeaux mixture is substituted for the application or applications before flowering?
6. How does Atomic Sulphur compare with dry and liquid lime-sulfur for the control of scab?
7. Does the addition of lime or of calcium caseinate to the combination lime-sulfur-lead arsenate spray improve the mixture?
8. For the control of apple scab, what is the fungicidal efficiency of sulfur dust? What is the effect of substituting a copper-lime-arsenic dust for the prepink and pink applications?

The rainy summer of 1922 was especially suitable for the experimental work, because of the abundant infection on unsprayed trees. The summer of 1923 was much drier; there was a rainfall of only 7.29 inches in May, June and July, as compared with 20.14 inches in the same period in 1922. This naturally resulted in less infection, but there was sufficient infection on unsprayed trees in every case but one to justify the drawing of conclusions as to the relative values of the several treatments applied.

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[1] The experiments here described were conducted in the orchards of Harry L. Knights of Littleton, H. L. Frost of Littleton, Stephen W. Sabine of Groton, and A. N. Stowe of Hudson. The superintendents of these orchards are Roy C. Wilbur of the Frost Farm, John J. Collins of the Stowe Farm, and J. W. Ames of the Knights Farm. Acknowledgment is due these men for placing their orchards at the disposal of the Experiment Station, and for cooperating in the investigations. Acknowledgment is also due to the Nashoba Fruit Producers' Association for their cooperation.

[2] Numbers in parenthesis refer to literature cited, see page 13.

The results, as given in tables I and II, and in the text, are expressed in percentage of scabby apples present in the check and in each sprayed or dusted plot. In interpreting the results of any spraying or dusting experiments, the percentage of infection in the check is of primary importance. If this is low, the data are correspondingly of less value, since it cannot be said that the fungicidal treatment was put to a real test. The percentage of infection on the unsprayed trees in the Sabine orchard where some of the spraying experiments were conducted was so low that the results in that orchard are not considered in this report.

Methods and Materials Used.

The trees used for these experiments were of the McIntosh variety. Each orchard was divided in such a way that the check plot was as nearly as possible like the treated plots in every way except fungicidal treatment received. The check plots received no treatment for scab control, but did receive a calyx application with insecticides only. All check plots were surrounded by or contiguous to the treated plots. In dividing an orchard for a dusting experiment, it is difficult to so locate the check plot that it will not receive some dust as the dust drifts through the orchard. If it were possible to prevent this entirely, the percentage of scabby fruits on the dust checks would probably be larger.

The following treatments were tested or compared:

1. Dry lime-sulfur 3–50 for the pink, calyx and one later application.
2. Dry lime-sulfur 3–50 with calcium caseinate added for the pink, calyx, and one later application.
3. Dry lime-sulfur 2–50 for the pink, calyx and one later application.
4. Dry lime-sulfur 4–50 for the pink, calyx and one later application.
5. Dry lime-sulfur 3–50 for the prepink, pink, calyx and one later application.
6. Bordeaux mixture 3–10–50 for the prepink and pink applications followed by liquid lime-sulfur 1–50 for the calyx and one later application.
7. Bordeaux mixture 3–10–50 for the pink application followed by liquid lime-sulfur 1–50 for the calyx and one later application.
8. Atomic Sulphur for the pink, calyx and one later application.
9. Liquid lime-sulfur for the pink, calyx and one later application.
10. Bordeaux mixture 3–10–50 for the pink application followed by dry lime-sulfur 4–50 for the calyx, and one later application.
11. Liquid lime-sulfur with lime added for the pink, calyx and one later application.
12. Copper dust for the prepink and pink applications followed by sulfur dust for the calyx and two later applications.
13. Sulfur dust for the prepink, pink, calyx and two later applications.
14. Sulfur dust with calcium caseinate added for the prepink, pink, calyx and two later applications.

In one orchard, the dusting schedule began with the pink instead of the prepink application.

An examination of Tables I and II will show which treatment each of the thirty-five plots received, including the fungicide and its dilution used at each application, together with the date of each application.

Rates of Application.

About four gallons of spray per tree per application were used for trees twelve to fifteen years old. About one and one-half pounds of dust per tree of this size were used at each application.

Liquid lime-sulfur was used at the rate of one gallon in fifty gallons of water. Dry lime-sulfur was used at the rate of two, three or four pounds in fifty gallons; this is expressed in abbreviated form in the text as dry lime-sulfur 2–50, 3–50, etc. It was not found necessary to add water to this material before placing it in the spray tank; in fact, to do so resulted in increased lumpiness. A more satisfactory method is to sift this material into the nearly filled spray tank with the agitator running.

Calcium caseinate spreader (which is sold under various trade names, such as Kayso, Spracein, etc.) was used at the rate of 1 pound in 100 gallons, or it was

added to sulfur dust so that the dust mixture would contain 5 per cent calcium caseinate.

The copper dust (used only before the flower buds opened) contained 11 per cent dehydrated copper sulfate. The sulfur dust contained 92 per cent sulfur and 8 per cent inert ingredients. When it was desired to apply an arsenical also to dusted trees, a dust containing sulfur and lead arsenate in the ratio 90:10 or 85:15 was used.

Arsenate of lead and nicotine sulfate (Black Leaf 40) in the usual proportions were added to the sprays for each application, except for the fourth summer spray when nicotine sulfate was omitted.

The spraying was done with power sprayers with about 200 pounds pressure, using Pilot rods or regular spray rods.

The dusting was done with power dusters, either Perfect or Niagara. The duster was driven along both sides of each row of trees, so that dust was applied to each tree from opposite sides. Dusting is not a pleasant operation, because of the pain caused by the sulfur getting into the eyes. Goggles, although somewhat of a nuisance, appear to be a necessity when much dusting is to be done. Some difficulty was experienced in thoroughly dusting the tops of tall trees. Krout (2) and Childs (3) both mention this. The tops of taller trees cannot be thoroughly coated with dust when any wind is blowing. The dusting was done early in the morning, beginning about five o'clock in most cases. The foliage was not always wet, however. There is no experimental evidence of the necessity of dusting only when the foliage is wet.

Friez hygro-thermographs and rain gauges were maintained in the Frost and Sabine orchards. The data on rainfall secured in the orchards is not considered complete, and the precipitation data given in this report are from the Concord observer for the United States Weather Bureau as recorded in Climatological Data for New England.

Because of the large yield of fruit, it was manifestly impossible to examine every apple in a plot at picking time. For this reason, four representative trees were selected from each plot for examination of the fruit. About 150,000 apples were examined. Since much of the infection was late, most of the scabby apples even on the check plots were marketable. Apples designated as scabby in the data include both marketable-scabby, and unmarketable scabby.

Effect of the Addition of a Prepink Application to the Schedule.

The delayed dormant application is made just as the buds are breaking or when the first tips of green show. The pink application is usually understood to mean that which is applied as soon as the blossom buds separate in the clusters, while they show pink, but before they begin to open. Any application of a summer-strength fungicide made between the delayed dormant and the pink applications may be spoken of as a prepink application. The interval between the prepink and pink applications, which will depend upon the weather and consequent rapidity of growth, is bound to be short. In the case of large orchards, there is likely to be no interval, so that an application begun as a prepink will end as a pink, as regards the development of the flower buds. The first summer application, either prepink or pink, should be made when the tree is first in danger of infection, that is, before the first discharge of winter spores from the dead leaves beneath the tree. It is probable that many of the failures to control apple scab in Massachusetts have occurred because this first summer spray was too long delayed. The prepink cannot be regarded as a substitute for the pink application. If a prepink application is necessary, a pink is none the less so, because new growth has exposed new and unprotected leaf surface to the danger of infection.

The beginning of the period when the tree is in danger of infection can be determined only by "trapping" the winter spores on adhesive-coated glass slides inverted over the dead leaves and microscopic examination of the slides, after the method described by Wallace (4) and Childs (5). In some years, winter spores are mature and ready to be discharged, if the dead leaves containing them are wet, while the apple buds are only beginning to swell. In such years, it is evident that if the first application is deferred until the flower buds show pink, some infection is

likely to occur before that time. Because a prepink application is proved necessary or unnecessary one year, it does not follow that the reverse may not be true the next year. A prepink application made in the absence of information as to the development and condition of the winter spores is to be regarded as insurance.

Krout (2) in 1922 tested the addition of a prepink application to the spray schedule. In the first orchard, the addition of the prepink application was not followed by a decrease in the percentage of scab but rather by an increase of 3 per cent. In each of two other orchards the prepink spray apparently reduced the scab 1 per cent. It is evident, therefore, that in 1922 no real benefit from the use of the prepink spray was shown, as compared with a schedule which included only a pink application before the flowers opened.

In 1923, spray schedules with and without a prepink application were tested in two orchards. In the Frost orchard trees sprayed with lime-sulfur beginning with the pink application yielded 7.06 per cent scabby fruit and when this material was used beginning with the prepink application, there was only 1.2 per cent scab, a significant reduction. Where Bordeaux mixture was used for the pink application, followed by lime-sulfur for the later applications, there was 1.7 per cent scabby fruit, and on the plot where this schedule was modified by the addition of a prepink application of Bordeaux mixture, only 0.6 per cent scabby fruit was produced. Here again there was a reduction in the percentage of scab, although such a small one as to be probably without significance.

In the Knights orchard, trees sprayed with dry lime-sulfur 4–50 beginning with the pink application, yielded 1.7 per cent scabby fruit, and where dry lime-sulfur 3–50 was applied beginning with the prepink spray, there was 4.8 per cent scabby fruit. Since the strength of the material was different the addition of a prepink application was not the only changed factor affecting the control of the disease. When the cost of the material and the cost of the labor for each application are considered, however, it is evident that three applications of dry lime-sulfur 4–50 beginning with the pink were a more profitable treatment than four applications of dry lime-sulfur 3–50 beginning with the prepink. There was 1.06 per cent scabby fruit on the trees sprayed with Bordeaux mixture beginning with the pink application and dry lime-sulfur 4–50 for the later applications. As compared with this there was 4.9 per cent scabby fruit on trees sprayed with Bordeaux mixture for the prepink and pink applications followed by liquid lime-sulfur for the later applications. Since, as is shown elsewhere in this report, we may regard liquid lime-sulfur as of equal fungicidal efficiency with dry lime-sulfur 4–50, it is evident that the addition of a prepink application did not reduce the percentage of scab; instead, it was followed by an increase of 3.84 per cent. The need of a prepink application is not shown by the data of either 1922 or 1923.

When we consider dusting, however, the case may be entirely different. In the two orchards where the dusting schedule began with a prepink application, a good control of scab was secured. In the orchard where only one application, the pink, was made before the flower buds opened a much poorer control resulted. Satisfactory experimental evidence on this point, however, would necessitate that the two schedules, with and without a prepink application, be used in adjoining parts of the same orchard with one check for the two.

The Use of Dry Lime-Sulfur.

Arguments for and against the use of dry lime-sulfur as compared with the liquid form include, of course, considerations of the relative costs, convenience in handling, and effect on the pump. But the first question to consider is, does it control scab? For if it does not, further consideration is needless. In the experiments here described, trees sprayed with dry lime-sulfur 4–50, beginning with the pink application, produced an average of 1.3 per cent scabby apples as compared with 60.7 per cent on the unsprayed trees. In the same orchards, on trees sprayed with liquid lime-sulfur, the percentage of scabby apples was 2.7. The conclusion from this is that dry lime-sulfur is fully as dependable for the control of apple scab as is liquid lime-sulfur.

In two successive years, Krout (2) secured as good control of apple scab with dry lime-sulfur as with the liquid. Gardner (6) found dry lime-sulfur as effective

as liquid lime-sulfur against apple scab. In most of the experiments of Keitt and Jones (7), the results with dry lime-sulfur in controlling apple scab were similar to those obtained with liquid lime-sulfur. Massey and Fitch (8) had practically the same results with dry as with liquid lime-sulfur.

Dry lime-sulfur is less bulky to transport. But the material necessary to make 100 gallons of spray costs about twice as much in the dry form as in the liquid. The so-called free sulfur in dry lime-sulfur does not redissolve in water, and this, according to Sears (9), wears out pumps and nozzles more rapidly than does liquid lime-sulfur. It may be added that if this objection is valid, it will hold none the less for dry-mix sulfur-lime, or any sulfur fungicide other than a solution. It seems that the orchardist must decide for himself whether to use dry or liquid lime-sulfur, but he may be sure that the fungicide in either form is efficient for the prevention of infection by the apple scab fungus.

Concentration at Which to Use Dry Lime-Sulfur.

Trees sprayed with dry lime-sulfur 4–50 yielded on the average 1.3 per cent scabby apples as compared to 60.7 per cent on unsprayed trees; while trees sprayed with dry lime-sulfur 2–50 and dry lime-sulfur 3–50 yielded 3.9 and 5.8 per cent scabby apples respectively, as compared to 67.6 per cent on unsprayed trees. The indications are that the use of less than 4 pounds of dry lime-sulfur in 50 gallons will be followed by a slight increase in the percentage of scabby apples.

Krout (2) secured similar results. The check plot yielded 41 per cent scabby fruit, the dry lime-sulfur 4–50 plot yielded 2 per cent, and the dry lime-sulfur 3–50 plot yielded 4 per cent scabby fruit. The difference was slight in 1922 as it is in 1923, but the variation is in the same direction.

Whether liquid or dry lime-sulfur is used, the protection afforded is dependent upon the amount of sulfur present in the diluted spray. The percentage of sulfur is of course not always the same in all dry lime-sulfurs. But in general it may be said that not less than 4 pounds of dry lime-sulfur in 50 gallons are required to supply the same number of pounds of sulfur as are present when 1 gallon of commercial concentrated lime-sulfur, of the usual strength tested in degrees Baumé, is diluted to 50 gallons. According to Dutton (10) the amount of dry lime-sulfur necessary to furnish the equivalent amount of sulfur in 50 gallons is 4.4 pounds, and according to Eustace and Pettit (11), it is 4.8 pounds.

The evidence submitted indicates that reducing the amount of dry lime-sulfur below 4 pounds to 50 gallons is a practice of doubtful economy.

Effect of a Calcium Caseinate Spreader on Control of Scab.

The percentage of scabby fruit was reduced slightly by the addition of calcium caseinate spreader to lime-sulfur. At Frost's, this reduction was from 7.06 to 5.08 per cent scabby fruit; and at Knights', the reduction was from 4.6 to 0.68 per cent. It is a question whether these reductions are in themselves large enough to be significant, but the results are consistently in favor of the use of the calcium caseinate.

The addition of calcium caseinate to sulfur dust did not result in a reduction in the percentage of scabby apples, as compared with the plots dusted with sulfur alone, in either the Frost or the Sabine orchard; and in the Stowe orchard the results were practically the same. In the Frost orchard, the addition of calcium caseinate spreader to sulfur dust was followed by a considerable increase in the percentage of scabby apples.

In the spreader tests of Stearns and Hough (12) the addition of calcium caseinate did not increase the effectiveness of the spray in protecting fruit and foliage from disease and insects. Keitt and Jones (7) secured slightly better control of scab when calcium caseinate was added to lime-sulfur than when the latter was used alone, but it was not considered that the commercial value of its addition was determined. Trees sprayed with lime-sulfur by Parrott, Stewart, and Glasgow (13) yielded 2.1 per cent scabby apples, while trees sprayed with lime-sulfur with calcium caseinate added yielded 4.8 per cent scabby apples. In the experiments of Massey and Fitch (8) trees sprayed with lime-sulfur yielded 1.2 per cent scabby apples, and those trees which were sprayed with lime-sulfur with calcium caseinate added

yielded 1.1 per cent scabby apples. In their dusting experiments, trees which received sulfur yielded 2.6 per cent scabby apples and those which were dusted with sulfur with calcium caseinate added yielded 2.4 per cent scabby apples.

The claim is made that calcium caseinate spreaders improve the adhesiveness of sprays, but it should be noted that Butler and Smith (14) found that the adhesiveness of Bordeaux mixture is not affected by the addition of calcium caseinate. Whatever may be said in favor of the use of calcium caseinate, and there are sound arguments in its favor, it cannot be said that there is sufficient or satisfactory evidence as to its increasing the fungicidal efficiency of lime-sulfur against apple scab to a point of commercial importance. It is probable, however, that the more imperfect the spraying, the greater the benefit to be derived from the use of a calcium caseinate spreader.

Calcium caseinate is further considered in connection with its effect on compatibility of ingredients in combination sprays.

Bordeaux Mixture as Compared with Lime-Sulfur for Applications Before Flower Buds Open.

The Bordeaux mixture used in these experiments was an excess-lime Bordeaux mixture containing 3 pounds of copper sulfate and 10 pounds of lime in 50 gallons of water. This is referred to in the abbreviated language of practice as 3–10–50 Bordeaux mixture. It was used, rather than a Bordeaux mixture containing copper sulfate and lime in the ratio 1:1, because it has been found to be somewhat safer to the sprayed tree.

In the preparation of Bordeaux mixture, the diluted copper sulfate solution and the diluted milk-of-lime may be poured together into a third barrel or into a spray tank, and this is a method quite generally followed. But it requires some special equipment and involves unnecessary labor. It is important that at least one of the stock solutions, either copper sulfate or lime, be diluted before the other and concentrated one is added to it, but as Butler (15) has shown, it is not necessary that both be diluted before mixing. In practice, it is sufficient to place the copper sulfate stock solution in the spray tank when it is about three-fourths full of water; then, with the agitator running, add the undiluted stock solution of the lime, and fill the tank with water. The Bordeaux mixture used in these experiments was prepared in this way.

In many experiments where Bordeaux mixture and lime-sulfur have been compared, it has been found that the former has a somewhat greater fungicidal efficiency than the latter against apple scab. Unfortunately, Bordeaux mixture usually burns the fruit and foliage of the apple. The results of many experiments are well illustrated by those of Krout (2) who found that even an excess-lime Bordeaux mixture of 3–10–50 formula, when used for all applications, russeted the fruit and burned the foliage severely. For this reason, the use of Bordeaux mixture throughout the spraying season was not attempted in 1923. It was, however, used on certain plots for the pink, or the prepink and pink applications, followed by lime-sulfur for later applications.

The plot in the Frost orchard which received three applications of liquid lime-sulfur yielded 2.1 per cent scabby apples, while the plot which received Bordeaux mixture for the pink application and liquid lime-sulfur for the calyx and last applications yielded 1.7 per cent scabby apples. This is too small a difference to have any significance. The plot which received the prepink and pink applications of Bordeaux mixture followed by liquid lime-sulfur for the later applications yielded 0.6 per cent scabby fruit. This reduction in the amount of scabby fruit cannot be attributed entirely to the substitution of Bordeaux mixture for lime-sulfur since this plot received one extra application; namely, the prepink. The results in Frost's orchard do not show that any benefit is to be derived from the substitution of Bordeaux mixture for lime-sulfur for the early application.

At the Knights orchard, Bordeaux mixture was substituted for dry lime-sulfur in one case and for liquid lime-sulfur in another for the pink or prepink and pink applications. The plot sprayed with dry lime-sulfur throughout the season yielded 1.7 per cent scabby fruit, and the plot on which Bordeaux mixture was substituted for dry lime-sulfur at the time of the pink application yielded practically the same; namely, 1.06 per cent scabby fruit. No benefit from the substitution of Bordeaux

was proved in this case. The plot sprayed with liquid lime-sulfur throughout the spraying season beginning with the pink application produced a slightly smaller percentage of scabby apples than did the plot which received Bordeaux mixture at the prepink and pink applications followed by liquid lime-sulfur for the calyx and fourth summer spray.

We have no evidence at either of these orchards that Bordeaux mixture is preferable to lime-sulfur for the prepink and pink applications. The labor involved in preparing Bordeaux mixture is sufficient to swing the scale against it in the absence of more evidence in its favor.

Dr. O. R. Butler states (in correspondence) that in his experiments in New Hampshire in 1922 where a spray schedule of lime-sulfur alone was followed, there was 67.5 per cent scabby fruit; while the substitution of Bordeaux mixture for the pink application reduced the amount to 49.2 per cent. Krout (2) reports that in the Sabine orchard in 1922 the substitution of Bordeaux mixture for lime-sulfur at the pink application did not reduce the percentage of scabby fruit, as compared with results following the use of lime-sulfur alone; in fact, in the case of both dry and liquid lime-sulfur, when Bordeaux mixture was substituted there was a larger percentage of scab. At the Knights and the Frost orchards, however, there was a slight decrease in the amount of scab when Bordeaux mixture was substituted for the pink application; in the case of liquid lime-sulfur this decrease was from 4 to 2 per cent in one orchard and 2 to 0 per cent in another, and in the case of dry lime-sulfur the decrease was from 8 to 3 per cent in one orchard and 2 to 1 per cent in another. We may conclude that although Bordeaux mixture under some conditions may prove slightly superior to lime-sulfur for the pink spray, there is, nevertheless, abundant evidence of the completely satisfactory control of apple scab by lime-sulfur throughout the spraying season; and it does not appear, therefore, that we have sufficient reason to devote extra labor to the preparation of Bordeaux mixture.

Atomic Sulphur.

The proprietary sulfur fungicide, Atomic Sulphur, was used in two orchards with a view to comparing it with lime-sulfur for its fungicidal efficiency and its toxicity to the sprayed tree. Enough of this material to make 100 gallons costs more than three times as much as the liquid lime-sulfur necessary to make an equal amount. Atomic Sulphur, therefore, needs to show very decided advantages over lime-sulfur if it is to compete with it in the spraying of apples.

There was this year no injury to fruit or foliage on trees sprayed with lime-sulfur or with Atomic Sulphur. It was, therefore, impossible to compare them as regards toxicity to the sprayed tree.

Mason (16) found that when apple trees were sprayed with a combination Atomic Sulphur-lime-lead arsenate spray, the foliage was uninjured, while under the same climatic conditions, foliage and fruit were burned by the lime-sulfur-lead arsenate combination.

Atomic Sulphur was used by the writer at the rate of 7 pounds to 50 gallons of water, and when it was used in combination with arsenate of lead, 4 pounds of lime slaked into a milk were added to each 50 gallons, as directed by the manufacturers. At one of the orchards, the results were as follows: Atomic Sulphur, 4.2 per cent scabby fruit; liquid lime-sulfur 2.1 per cent scabby fruit; dry lime-sulfur 4–50, 1.03 per cent scabby fruit. At this orchard, the control secured by Atomic Sulphur was somewhat surpassed by both dry lime-sulfur and liquid lime-sulfur. At the other orchard, the percentages of scabby fruit were as follows: Atomic Sulphur, 3.9 per cent; dry lime-sulfur 3–50, 4.6 per cent. At this orchard also, the results with the two materials are very nearly alike.

If Atomic Sulphur has any advantages over lime-sulfur, they are not to be found in relative efficiency in scab control, but rather in degrees of difference in toxicity to the sprayed plant. Apple orchards in which peaches are planted as fillers are sometimes sprayed with Atomic Sulphur because of the known danger to peaches in leaf from the use of commercial lime-sulfur. When this is done, we may be sure that the apples have received treatment with a fungicide which can protect them against scab infection.

Compatibility of the Ingredients in the Combination Spray as Affected by Addition of Lime, Calcium Caseinate, and Order of Mixing.

Apples are not often sprayed with lime-sulfur alone. They are now more often sprayed with a mixture of lime-sulfur, lead arsenate, nicotine sulfate, and calcium caseinate. The reaction between lead arsenate and lime-sulfur has been studied by Ruth (17) and others, and it is known that both of these materials are somewhat decomposed, one of the results being the formation of the black sludge, lead sulfide. Relative blackness of the mixture is an indicator of its lack of desirable qualities. So far as is known, the addition of nicotine sulfate does not affect this reaction. It has been shown by numerous investigators that the addition of arsenate of lead to lime-sulfur increased the fungicidal value of the latter. Although the use of such a combination spray controls apple scab as well or probably better than lime-sulfur alone, the formation of soluble arsenic as a result of the reaction increases the danger of foliage burning.

It has been found by Robinson (18) that by the addition of lime to this combination spray, the percentage of the soluble, and therefore dangerous, arsenic in the combination spray can be reduced. After standing two days, most of the lime-sulfur with lime added remained unchanged, while in lime-sulfur alone, the desirable polysulfide sulfur had all been changed into lead sulfide or thiosulfate. Bourne (19) modified Robinson's method by adding milk-of-lime to lead arsenate and then adding the two together to diluted lime-sulfur. He found this resulted in very little sediment or blackening. He diluted lime-sulfur till the spray tank was nearly full. Lime (at the rate of 10 pounds to 100 gallons of the total mixture) was slaked and water added to make a milk. Arsenate of lead was stirred into the milk-of-lime, which was then strained into the spray tank with the agitator running. Krout (2) compared liquid lime-sulfur with liquid lime-sulfur plus lime in the field. In each of the three orchards where he used it, there was no russeting of the fruit by either lime-sulfur alone, or lime-sulfur with lime added, and so the benefit of the addition of lime in reducing burning was not shown. In each of the three orchards sprayed by Krout, the addition of lime to lime-sulfur was followed by an increase in the percentage of scabby fruit over the percentage on trees sprayed with lime-sulfur without lime, the increases being 10, 3, and 8 per cent, respectively.

In the experiments of 1923, there was no russeting or burning on trees sprayed with lime-sulfur or on those sprayed with lime-sulfur plus lime. Hence in 1923, as in 1922, it was impossible to prove that the addition of lime to lime-sulfur reduced the toxicity of the fungicide to the sprayed tree. In both of the orchards where these materials were compared in 1923, a larger percentage of scabby apples was produced on trees sprayed with lime-sulfur plus lime than on trees sprayed with lime-sulfur without lime added, the increase being 1.2 per cent in one case and 5.3 per cent in the other. The indications are that the addition of lime to the lime-sulfur-lead arsenate combination spray reduces somewhat the fungicidal efficiency of the latter. In seasons when climatic conditions result in toxicity to the sprayed tree by the lime-sulfur-lead arsenate combination spray, it is possible that any small decrease in fungicidal efficiency coincident with the addition of lime would be more than offset by the decreased danger of burning described by Robinson (loc. cit.) and Bourne (loc. cit.). However, further experimental evidence is needed.

According to Regan (20) the addition of calcium caseinate spreader to lime-sulfur-lead arsenate combination spray prevents the usual decomposition and formation of black sludge. He found two pounds of calcium caseinate to be more effective in preventing this decomposition than ten pounds of hydrated lime. Lovett (21) also reports that the addition of calcium caseinate materially delays the reaction between lime-sulfur and lead arsenate in the combination spray.

Laboratory tests were made by the writer to compare the formation of black sludge in the combination spray with and without the addition of calcium caseinate. Without calcium caseinate, the color of the mixture was dark citrine[1] and with it the color was yellowish citrine, that is, considerably lighter. After standing three minutes the sludge precipitated without calcium caseinate was nearly twice

[1] Colors determined by comparison with Ridgway, Robert. Color Standards and Nomenclature. Washington, 1912.

as much as the sludge in the mixture containing calcium caseinate. Apparently the addition of calcium caseinate physically improves the mixture.

In filling the spray tank, five ingredients are or may be used, *i.e.*, water, lime-sulfur, lead arsenate, nicotine sulfate and calcium caseinate. After the water is in the tank, there are twenty-four different orders in which the other ingredients may be added. The manufacturers of calcium caseinate recommend that it be added to the water in the spray tank, with the agitator running, before the other materials are added. According to Anderson and Roth (22) the lime-sulfur is first diluted, the lead arsenate added to it with agitation, and then the nicotine sulfate added. After putting the calcium caseinate in the water in the spray tank, this is probably the order most commonly followed. Britton (23) recommends the following order for filling the spray tank: first, clean water; second, nicotine sulfate; third, calcium caseinate (if used); fourth, lead arsenate; and fifth and last, lime-sulfur. He says that when mixed in this order, especially if calcium caseinate is present, little or no discoloration or precipitation of brown sludge follows.

In laboratory tests made by the writer, the ingredients were mixed in the order named by Britton; the resulting mixture was buffy olive in color, with little precipitation. In another test they were mixed in the following order: water, calcium caseinate, lime-sulfur, lead arsenate, and nicotine sulfate. The color of this mixture was ivy green, considerably darker, with more precipitation. Several other orders of mixing were compared and the best results, based on a color test and relative sludge formation, were obtained by the following sequence after the water: first, calcium caseinate; second, nicotine sulfate; third, lead arsenate; and fourth, lime-sulfur.

Spore germination tests made with the conidia of the apple scab fungus showed that the fungicidal efficiency of the combination spray is not impaired by any order of mixing tested. But the order of mixing does affect the physical qualities of the mixture and very probably the burning of the sprayed tree. It should be added that when light colored lime-sulfur combination spray is desired, special attention should be given to washing out the spray tank. The use of calcium caseinate results in a decidedly lighter colored mixture.

Results of Dusting Treatments.

A rather extensive literature on the results of dusting for the control of apple scab has come into existence. The results do not all agree, but perhaps they are no more inconsistent than the published results of spraying experiments. In general, the control of apple scab by the use of dusts has been surpassed by that of liquid sprays. This is not surprising when we consider that spraying is a much older orchard practice than is dusting. Our knowledge of the use of liquid sprays and the schedule for their application to the apple is relatively advanced. Dusts have been used in conformity with the spray schedule, rather than according to any special dusting schedule.

It should be noted that no experiments have been conducted in Massachusetts which directly compare the results of spraying with those of dusting. Owing to the topography and plan of the several orchards, spraying and dusting experiments have been carried on in separate orchards or in separate parts of the same orchard with one check plot for the spray treatment and another for the dust treatment.

In the orchards dusted by Krout (2) in 1922 the average percentage of scabby fruit in the check plots was 75.8 and the average percentage of scabby fruit in the plots dusted with sulfur was 17.2. In the orchards sprayed by Krout, the average percentage of scabby fruit in the check plots was 79.0 and the average percentage of scabby fruit in the plots sprayed with dry lime-sulfur 4–50 was 8.0. It is evident that the dust did not give a control equal to that of the spray. The results of Massey and Fitch (8) were: in one orchard, check 93.3 per cent scab, and sulfur dust 13.5 per cent scab; in another orchard, check 43.5 per cent scab and sulfur dust 3.1 per cent scab. In an orchard dusted by Parrott, Stewart, and Glasgow (13), the results were 83.9 per cent scab in the check, and 47.8 per cent scab in the plot dusted with sulfur. Results from other years and other states could be selected either in favor of or against dusting.

In 1923, the dusting experiments here reported were conducted in three orchards. At the Stowe and the Sabine orchards, the dusting schedule consisted of five appli-

cations, *i.e.*, prepink, pink, calyx, fourth dust and fifth dust. At the Frost orchard, the trees were dusted four times, no prepink application being used.

In the Stowe orchard, where check trees yielded 37 per cent scabby fruit, trees dusted with sulfur yielded 3.7 per cent scabby fruit. At the Sabine orchard, trees dusted with sulfur bore 0.5 per cent scabby fruit, and on the check trees 48 per cent of the fruit was scabby. At the Frost orchard, where no prepink application was used, trees dusted with sulfur yielded 16.9 per cent scabby fruit, as compared with 84.5 per cent scabby fruit in the check. Sulfur dust controlled apple scab satisfactorily when applications began with the prepink, but not when the prepink application was omitted.

Calcium caseinate was thoroughly mixed with sulfur at the rate of 5 pounds of calcium caseinate to 95 pounds of sulfur. This sulfur-calcium caseinate dust was used in three orchards in plots adjoining plots dusted with sulfur only. In every case, apple scab was controlled better by sulfur alone than by sulfur with calcium caseinate added.

Plots were also dusted according to a schedule which included the use of a copper dust for the prepink and pink, or the pink applications followed by sulfur dust for later applications. At two of the orchards, there was less scab following the use of sulfur throughout the season than when copper dust was substituted for sulfur for the applications before the flower buds opened. At the other orchard, there was only a negligible difference between the amounts of scab following the two different methods of treatment. No experimental evidence was secured to indicate an advantage in using copper dust instead of sulfur dust for the early applications.

Control of Primary Infection on Leaves.

As the season advances, the work of the fungicide and the conditions under which it acts become entirely different from what they were at the first of the spraying season. There is naturally and usually an increase in the mean temperature. At the time of the early applications, all infection is from the winter spores. As soon as scab lesions appear on the young leaves, there is an increasing possibility of infection by the summer spores. In some springs, the trees are for a few days, or even a few weeks, in danger of infection from both the winter and summer spores at the same time. In the absence of sufficient moisture the ejection of the winter spores may be prolonged until after the appearance of scab on the leaves.

In 1923, ejection of winter spores from the dead leaves beneath the trees was first observed on May 2. Spore ejection continued till June 16, after which none was observed. The first scab symptoms were found on the leaves May 22. It is evident from this that the first winter spores to be ejected did not infect the trees, for the incubation period with these spores of the apple scab fungus was found by Wallace (4) to be eight to fifteen days. During the period in which winter spore ejection continued, there was rain on ten days. Whenever the leaves were wet by rain, winter spore ejection was stimulated, but it was fully as abundant on certain days when the leaves were wet with heavy dew. Winter spores were not ejected in relatively great numbers at any time the last spring. . Wallace (loc. cit.) reports that in order for winter spores to infect the trees, the trees must remain wet 8 to 10 hours. Such was the condition on May 12 and 21 and on June 8, and it is probable that much of the primary infection took place on these dates.

In order to secure more information on the relative fungicidal efficiency of the several treatments, the percentages of infected leaves on trees June 18 were determined. In the Frost sprayed orchard, there were at this time 39 per cent scabby leaves on the check trees, and from 0.1 to 0.3 per cent scabby leaves on the sprayed trees, with only negligible differences between the several spray treatments. All the spray treatments were practically successful in preventing the primary infection. The results were essentially the same in both of the Knights orchards, where there were 15 and 20 per cent scabby leaves on unsprayed trees, and 0.1 to 0.2 per cent scabby leaves on sprayed plots, again with negligible differences between the different spray treatments.

Upon examining the dusted orchards, it was found that the primary infection had not been as satisfactorily prevented. In one orchard where the dust treatments began with a prepink application, the check trees had 41 per cent scabby leaves, and the dusted trees had 8 to 9 per cent scabby leaves, with only minor differences between the different dust treatments. In another orchard dusted in

the same way, there were 15 per cent scabby leaves on the check trees and 3 to 4 per cent scabby leaves on the dusted trees. In the third orchard, where no prepink application was used, there were at this time 53 per cent scabby leaves on the check and 21 to 24 per cent scabby leaves on the dusted trees. This indicates the necessity of a prepink application if dust is to control the primary infection. But even where both prepink and pink applications of dust were made, relatively more primary infection occurred than in the sprayed orchards. As is explained elsewhere, the dust treatments in the orchards where dusting began with a prepink application, were entirely satisfactory in preventing the further spread of scab, that is, in preventing infection later in the season by the summer spores. It would appear that if dust is equally as efficient as liquid spraying in controlling the spread of scab during the summer, it is less efficient in preventing the primary infection in early spring. If such is the case, then for those who own both duster and sprayer, a safer procedure would be to use the sprayer for the pink application and the duster for later ones. It should not be overlooked, however, that dust satisfactorily controlled scab on the fruit when the dusting schedule included both a prepink and pink application.

Effect of Fungicides on the Tree.

The literature contains references to increased dropping of the fruit following the use of lime-sulfur. There was this year in the experimental orchards no more dropping of the fruit following any of the several treatments than that which occurred on the check trees.

There was only a negligible amount of injury to fruit or foliage on any of the sprayed or dusted plots. The trees used are McIntosh. Although burning was absent in the experimental plots, it was seen on the fruit of Baldwins following the application of sulfur dust. Childs (3) and others report that sulfur dust may cause an injury to apple fruit similar to that of lime-sulfur solution. The relation of sulfur dust burning to temperature in the case of varieties susceptible to burning needs to be further considered. As has been pointed out by Safro (24) some cases of injury attributed to lime-sulfur are primarily cases of sunburn, and the same is probably true of injury by sulfur dust. The absence of spray injury from all plots made it impossible to learn to what extent the addition of lime to lime-sulfur decreases burning, and how the latter fungicide compares with Atomic Sulphur in this respect on the apple.

Relation of Temperature of the Season to the Fungicidal Efficiency of Sulfur.

We have as yet no data on the temperature necessary for sulfur to prevent the germination of the winter spores of the apple scab fungus. Doran (25) has shown that sulfur prevents the germination of the summer spores of this fungus when the temperature is 78.8° F. for five hours. If the temperature is higher, less time is necessary and if the temperature is lower, more time is necessary. This temperature or above it was recorded in the experimental orchards on fifty days between May 7 and August 31. As the results show, the temperature conditions of the season were such as to insure the fungicidal action of sulfur, and so prevent the germination of the conidia.

If there had been fewer days during this period when the temperature reached the necessary point, it is probable that the results with Bordeaux mixture and copper dust as compared with sulfur fungicides would have appeared relatively better than proved to be the case.

Summary.

A spray schedule beginning with the pink application controlled apple scab as well as a schedule beginning with the prepink application.

Sulfur dust controlled apple scab satisfactorily when it was applied five times beginning with the prepink application, but not when it was applied four times beginning with the pink application.

Liquid lime-sulfur 1–50 and dry lime-sulfur 4–50 proved of equal fungicidal efficiency for scab control.

Less than 4 pounds of dry lime-sulfur in 50 gallons did not on the whole control scab quite as well as dry lime-sulfur 4–50.

The addition of calcium caseinate spreader to the liquid spray was followed by a very slight decrease in the percentage of scabby fruit.

The addition of calcium caseinate spreader to sulfur dust did not result in a smaller percentage of scabby fruit than when sulfur dust was used alone.

Since there was no injury to the sprayed tree by lime-sulfur-lead arsenate combination spray, it could not be proved that the addition of lime to this spray decreased its toxicity to the sprayed tree.

As good a control of apple scab was secured by the use of lime-sulfur throughout the spraying season as by substituting Bordeaux mixture for lime-sulfur for the applications before the flower buds opened.

Atomic Sulphur controlled the disease as well as did lime-sulfur. Because of the absence of burning it was impossible to determine how they compare in their effect on the sprayed tree.

Sulfur dust throughout the dusting season controlled apple scab as satisfactorily as when copper dust was substituted for sulfur dust for the applications before the flower buds opened.

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APPENDIX.

TABLE I. — *Showing Treatment of Dusted Plots with Dates of Applications, Materials used and Percentage of Scabby Fruit.*

Orchard.	Plot No.	Prepink.		Pink.		Calyx.		Fourth (or Third) Summer.		Latest Summer.		Per Cent Scabby Fruit.
		Material.	Date.	Material.	Date.	Material.	Date.	Material.	Date.	Material.	Date.	
Stowe	1	Copper-lime-arsenic-dust	May 5	Copper-lime-arsenic-dust	May 10	Sulfur dust	May 21	Sulfur dust	June 11	Sulfur dust	July 18	2.9
	2	Sulfur dust	5	Sulfur dust	10	Sulfur dust	21	Sulfur dust	11	Sulfur dust	18	3.7
	3	Check (no treatment)										37.0
	4	Sulfur dust plus calcium caseinate	5	Sulfur dust plus calcium caseinate	10	Sulfur dust plus calcium caseinate	21	Sulfur dust plus calcium caseinate	11	Sulfur dust plus calcium caseinate	18	3.9
Frost	1	Check (no treatment)										84.5
	2			Sulfur dust	8	Sulfur dust	22	Sulfur dust	13	Sulfur dust	19	16.9
	3			Sulfur dust plus calcium caseinate	8	Sulfur dust plus calcium caseinate	22	Sulfur dust plus calcium caseinate	13	Sulfur dust plus calcium caseinate	19	30.7
	4			Copper-lime-arsenic dust	8	Sulfur dust	22	Sulfur dust	13	Sulfur dust	19	17.6
Sabine	1	Check (no treatment)										48.0
	2	Copper-lime-arsenic dust	4	Copper-lime-arsenic dust	9	Sulfur dust	24	Sulfur dust	12	Sulfur dust	17	4.8
	3	Sulfur dust	4	Sulfur dust	9	Sulfur dust	24	Sulfur dust	12	Sulfur dust	17	0.5
	4	Sulfur dust plus calcium caseinate	4	Sulfur dust plus calcium caseinate	9	Sulfur dust plus calcium caseinate	24	Sulfur dust plus calcium caseinate	12	Sulfur dust plus calcium caseinate	17	0.7

TABLE II. — *Showing Treatments of Sprayed Plots with Dates of Applications, Materials used and Percentage of Scabby Fruit.*

Orchard.	Plot No.	Prepink.		Pink.		Calyx.		Latest Summer.		Per Cent Scabby Fruit.
		Material.	Date.	Material.	Date.	Material.	Date.	Material.	Date.	
Frost	1		May	Dry lime-sulfur 3-50 plus calcium caseinate	May 7	Dry lime-sulfur 3-50 plus calcium caseinate	May 24	Dry lime-sulfur 3-50 plus calcium caseinate	June 13	5.08
	2			Dry lime-sulfur 3-50	7	Dry lime-sulfur 3-50	24	Dry lime-sulfur 3-50	13	7.06
	3			Dry lime-sulfur 4-50	7	Dry lime-sulfur 4-50	24	Dry lime-sulfur 4-50	13	1.03
	4			Dry lime-sulfur 2-50	7	Dry lime-sulfur 2-50	24	Dry lime-sulfur 2-50	13	5.07
	5	Dry lime-sulfur 3-50	3	Dry lime-sulfur 3-50	7	Dry lime-sulfur 3-50	24	Dry lime-sulfur 3-50	13	1.2
	6	Check (no treatment)								76.0
	7	Bordeaux mixture	3	Bordeaux mixture	7	Liquid lime-sulfur	24	Liquid lime-sulfur	13	0.6
	8			Bordeaux mixture	7	Liquid lime-sulfur	24	Liquid lime-sulfur	13	1.7
	9			Liquid lime-sulfur	7	Liquid lime-sulfur	24	Liquud lime-sulfur	13	2.1
	10			Liquid lime-sulfur plus lime	7	Liquid lime-sulfur plus lime	24	Liquid lime-sulfur plus lime	13	3.3
	11			Atomic Sulphur	7	Atomic Sulphur	24	Atomic Sulphur	13	4.2

Table II. — *Showing Treatments of Sprayed Plots with Dates of Applications, Materials used and Percentage of Scabby Fruit* — Concluded.

Orchard.	Plot No.	Prepink.		Pink.		Calyx.		Latest. Summer.		Per Cent Scabby Fruit.
		Material.	Date.	Material.	Date.	Material.	Date.	Material.	Date.	
Knights (A)	1	Bordeaux mixture	May 3	Bordeaux mixture	May 8	Liquid lime-sulfur	May 23	Liquid lime-sulfur	June 14	4.9
	2			Bordeaux mixture	8	Dry lime-sulfur 4–50	23	Dry lime-sulfur 4–50	14	1.06
	3			Liquid lime-sulfur plus lime	8	Liquid lime-sulfur plus lime	23	Liquid lime-sulfur plus lime	14	8.6
	4			Liquid lime-sulfur	8	Liquid lime-sulfur	23	Liquid lime-sulfur	14	3.3
	5	Check (no treat-ment)								45.5
	6	Dry lime-sulfur 3–50	3	Dry lime-sulfur 3–50	8	Dry lime-sulfur 3–50	23	Dry lime-sulfur 3–50	14	4.8
	7			Dry lime-sulfur 4–50	8	Dry lime-sulfur 4–50	23	Dry lime-sulfur 4–50	14	1.7
Knights (B)	1			Dry lime-sulfur 2–50	8	Dry lime-sulfur 2–50	23	Dry lime-sulfur 2–50	14	2.7
	2			Dry lime-sulfur 3–50 plus calcium caseinate	8	Dry lime-sulfur 3–50 plus calcium caseinate	23	Dry lime-sulfur 3–50 plus calcium caseinate	14	0.68
	3			Dry lime-sulfur 3–50	8	Dry lime-sulfur 3–50	23	Dry lime-sulfur 3–50	14	4.6
	4			Atomic Sulphur	8	Atomic Sulphur	23	Atomic Sulphur	14	3.9
	5	Check (no treat-ment)								59.3

TABLE III. — *Results of Three Years' Apple Spraying Experiments.*

Treatment.[1]	Per Cent Scabby Fruit — 1923.	1922.	1921.	Average.
Check	58.3	77.0	91.0	75.4
Liquid lime-sulfur	2.7	6.6	8.6	6.1
Liquid lime-sulfur plus lime	5.9	13.6	12.0	10.3
Dry lime-sulfur 4–50	1.3	8.0	6.0	5.1
Dry lime-sulfur 4–50 beginning with prepink	–[2]	0.0	–	0.0
Dry lime-sulfur 3–50	5.8	4.0	–	4.9
Dry lime-sulfur 3–50 beginning with prepink	3.0	–	–	3.0
Dry lime-sulfur 2–50	3.9	–	–	3.9
Dry lime-sulfur 3–50 plus calcium caseinate spreader	2.9	–	–	2.9
Atomic Sulphur	4.0	–	–	4.0
Bordeaux mixture at pink application followed by dry lime-sulfur 4–50	1.0	18.3	–	9.6
Bordeaux mixture at pink application followed by liquid lime-sulfur	1.7	6.0	6.0	4.5
Bordeaux mixture for prepink and pink applications followed by liquid lime-sulfur	2.7	7.0	–	4.8
Bordeaux mixture through season	–	8.6	–	8.6
Sulfur dust beginning with prepink application	2.1	17.2	–	9.6
Sulfur dust beginning with pink application	16.9	–	46.0	31.4
Sulfur dust plus calcium caseinate beginning with prepink application	2.3	–	–	2.3
Sulfur dust plus calcium caseinate beginning with pink application	30.7	–	–	30.7
Copper dust for prepink and pink applications followed by sulfur dust	3.8	–	–	3.8
Copper dust for pink application followed by sulfur dust	17.6	–	–	17.6
Copper dust through season	–	10.2	69.0	39.6

[1] Applications begin with pink unless stated as beginning with prepink.
[2] Blanks in table indicate that the treatment was not given in that year.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION

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CORRELATION STUDIES ON WINTER FECUNDITY

By F. A. HAYS, RUBY SANBORN and L. L. JAMES

In plant and animal breeding it is impossible to make or effect changes in one character without running the risk of profoundly modifying, sometimes unfavorably, other characters. Such is the common experience of poultry breeders, abundantly confirmed by scientific investigation. For this reason it is essential that the relation existing between the major character in which improvement is sought, and other characters with which it may be associated, be established. In this report the results of such a study in poultry breeding are presented. The bulletin is technical in its nature, and is addressed primarily to those poultry breeders who are attempting to make thorough study of the science on which their art is based.

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AGRICULTURAL EXPERIMENTAL STATION

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CORRELATION STUDIES ON WINTER FECUNDITY

By F. A. Hays, Ruby Sanborn and L. L. James

High winter egg production is very desirable from the poultry keeper's point of view for two reasons: first, prices for eggs are much more remunerative during the winter months than at any other season; second, winter egg yield is intimately correlated with annual egg yield (Hervey 1923).

The number of eggs that a pullet will lay from first egg to March first depends upon seven pairs of Mendelian factors as has been shown by Hays (1924). This being the case, winter egg production cannot be correctly considered as a simple physiological character but rather as the manifestation of the interaction of the characters of a complex. Such traits as sexual maturity, winter pause, intensity, and broodiness have a definite and measurable relation to the number of winter eggs when large numbers are considered. Each of these four major traits affecting winter fecundity is unquestionably subjected to and modified by varying conditions that we may call "environmental" for lack of a more specific term.

In the studies reported below an attempt has been made to measure by means of the coefficient of correlation the degree of association of some measureable variables with winter egg yield. The chief value of such a study lies in the fact that, knowing the relative importance of the variables considered in relation to winter production, the breeder should be able by controlling major variables such as age at first egg, hatching date, rate of growth, etc., to attain higher winter averages and to secure greater uniformity in the winter fecundity of his flock. For example, if the flock is mated in such a way as to secure only genetically early maturing pullets, the age at first egg will range from about 150 to 210 days, while in a flock such as ours that is not genetically pure for early maturity the age at first egg ranges from 150 to 300 days.

Data Available.

A total of 959 Rhode Island Red Pullets hatched in eleven weekly broods from March 25 to June 3, 1923 are studied. This flock includes rather heterogenious breeding when winter fecundity is considered. Included in this flock are birds bred for the following characteristics: high winter and annual fecundity, non-broodiness and broodiness, good color, inbred and outbred, and hatching power of eggs. Taken as a whole, this flock may be considered good, but not equal to the standards set by those birds bred for fecundity alone. The mean of 803 birds that have complete winter records is 45 eggs.

Coefficient of Correlation

Coefficient of correlation is here used as a measure of association or dependence of one trait upon another. For example, in a particular flock of pullets if the degree of correlation between age at first egg and winter egg record is −.64, such a constant indicates that large winter records depend on early maturity in 64 birds out of every hundred, and that sexual maturity is one very important factor in determining the winter record of such pullets. A + sign before the coefficient .64 would mean that late sexual maturity is associated with large winter egg records. Other factors, such as hatching date, 150-day weight, weight at first egg, daily gain in weight, etc., may be measured in a similar manner. A comparison of the coefficients of correlation for these different factors furnishes a measure of their relative importance. Selection based on the coefficient of correlation should be applied to flocks rather than to individual birds as is evident in tables 1 and 2.

The word *mean* has the same meaning as average. *Standard deviation* shows the range of variation of a group of individuals above or below the mean or average. If the mean hatching date is 6.68 and its standard deviation is ±2.95, the interpretation is that the average range in hatching date of the flock

in question is from 3.75 (6.68 − 2.95 = 3.75) to 9.63 (6.68 + 2.95). The *probable error* is written with a ± sign after each coefficient of correlation. It is used as a measure of the reliability of the figure given. Thus the degree of correlation between hatching date and weight at 150 days is −.3293 ± .0194. The meaning is that if we add .0194 to the coefficient of correlation and also subtract .0194 from the coefficient of correlation, we obtain two figures, namely, .3099 and .3487. The chances are even that the true coefficient of correlation between hatching date and 150-day weight lies inside or outside of these limits. A coefficient of correlation at least three times as large as its probable error is considered as significant.

Hatching Date

Part of the data is presented below in tabular form to show the general relation of hatching date to weight at 150 days, weight at first egg, age at first egg, and winter production, together with the average number of birds concerned in all four cases. This table will be particularly useful for general reference.

Table 1.

Hatches	Avg. No. of Birds	Wt. at 150 Days—lbs.	Wt. at First Egg—lbs.	Age at First Egg—Days	Winter Egg Prod.
March 25 (1)	41	4.22	5.73	212	58
April 1 (2)	55	4.27	5.75	211	56
April 8 (3)	61	4.23	5.94	212	57
April 15 (4)	76	4.11	5.92	221	46
April 22 (5)	69	4.18	5.94	215	48
April 29 (6)	80	3.99	5.69	217	47
May 6 (7)	105	3.89	5.62	219	39
May 13 (8)	83	4.05	5.50	208	42
May 20 (9)	113	3.72	5.22	206	41
May 27 (10)	91	3.74	5.15	202	38
June 3 (11)	82	3.72	5.13	201	34

The 150-day weight is observed to decrease rather regularly as the date of hatching advances. This fact substantiates common observation that early hatching seems to be associated with rapid growth. The weight at first egg for the different hatches shows little consistency, but as a rule, the earlier hatched birds appear to be somewhat heavier than the late hatched. The inconsistency is no doubt due in large measure to the wide range in age at first egg. Age at first egg seems to be but little dependent upon hatching date. In the last three or four hatches, however, there appears to be a reduction in the average age at first egg. Hatching date is intimately associated with winter production. In other words, the early broods as a rule lay more winter eggs than later broods. In general, hatching date appears to influence the weight at 150 days and the winter production with probably some influence upon weight at first egg and age at first egg.

As already stated, the pullets were hatched at one week intervals beginning March 25 and ending June 3. Thus eleven different age groups are represented with a range in age of 70 days. Hatching date is studied in relation to weight at 150 days, weight at first egg, age at first egg, and winter production:

Hatching Date versus Weight at 150 Days

Number of birds	959
Mean hatching date	6.68
Hatching date standard deviation	±2.95
Mean 150-day weight	3.96
150-day weight standard deviation	±.56
Coefficient of correlation	−.3293±.0194

The fact will be noted that the mean hatching date is 6.68 (May 4) instead of 6.00 (April 29) as would be the case if each hatch had produced the same

number of birds. The actual date may be calculated easily in each case. It is interesting to note that the pullets averaged 3.96 pounds at 150 days old.

The coefficient of correlation between hatching date and 150-day weight is $-.3293 \pm .0194$. This is a significant correlation and substantiates common observation that early hatching tends to give larger pullets at a given age than does late hatching. In about one case out of three there was direct association between early hatching and heavy weight. In the other two cases out of three there was no relation between 150-day weight and hatching date. Other influences were operating in two cases out of three to overcome any effect of hatching date on weight at 150 days.

Hatching Date versus Weight at First Egg.

Number of birds	820
Mean hatching date	6.66
Hatching date standard deviation	± 2.92
Mean weight at first egg	5.65
Weight at first egg standard deviation	$\pm .75$
Coefficient of correlation	$-.3807 \pm .0201$

The mean weight at first egg is 5.65 pounds. The coefficient of correlation between hatching date and weight at first egg is $-.3807 \pm .0201$. The correlation shows that early hatched pullets tend to be heavier when they lay their first egg than do their later hatched sisters. This fact is in accord with the observations on weight at 150 days. In four cases out of ten the weight at first egg is directly associated with hatching date. Possibly the degree of correlation between time of hatching and weight at first egg is greater than that between time of hatching and 150-day weight because late hatching tends to reduce the mean age at first egg as will be shown below.

Hatching Date versus Age at First Egg.

Number of birds	840
Mean hatching date	6.64
Hatching date standard deviation	± 2.92
Mean age at first egg	210.99 days
Age at first egg standard deviation	± 28.91
Coefficient of correlation	$-.1487 \pm .0228$

The mean age at first egg is 210.99 days and its standard deviation is 28.91. Thus the age range is wide as will be observed from the relative magnitude of standard deviation and mean.

The coefficient of correlation is negative and amounts to $.1487 \pm .0228$. Thus in one case out of seven late hatching is associated with early sexual maturity. Such a constant suggests that late hatching tends to reduce the length of growth period prior to laying and this is in part responsible for the lighter weight at first egg in late pullets compared with early ones as was pointed out in the previous section.

Hatching Date versus Winter Production.

Number of birds	802
Mean hatching date	6.59
Hatching date standard deviation	± 2.97
Mean winter production	44.48
Winter production standard deviation	± 23.06
Coefficient of correlation	$-.2920 \pm .0218$

The mean egg production of the 802 birds studied up to March first is 44.48. The magnitude of the standard deviation shows a wide range in winter fecundity within the flock. This wide range in fecundity is to be expected because of the range in hatching date and because of the range in age at first egg as well as because of genetic differences in the individuals in winter pause, intensity, and broodiness.

A negative coefficient of correlation amounting to .2920±.0218 exists between hatching date and winter production. All other conditions being the *same*, there could not but be a negative correlation because the early hatched pullets have longer to lay. The fact that in less than one case out of three is early hatching directly associated with greater winter egg yield can be due only to the condition that a good percentage of early hatched pullets complete their winter cycle of laying and lose considerable time in winter pause while fewer later hatched pullets actually pause.

By reducing the range in age at first egg, a more accurate measure of the degree of association between early hatching and high winter egg production is obtained. The coefficient of correlation has been calculated between hatching date and winter egg record using only those birds beginning to lay at 206 days or less. The constants obtained on this group are as follows:

Number of birds	418
Mean hatching date	6.96
Hatching date standard deviation	±3.19
Mean winter production	54.93
Winter production standard deviation	±21.06
Coefficient of correlation	−.4790±.0254

In the above group of birds the 70 day range in hatching date is greater than the 50 day range in age at first egg. In other words, all birds maturing at 206 days or less are the same genetically for sexual maturity as was pointed out earlier (Hays 1924). With such a group of birds high winter fecundity is associated with early hatching in fifty per cent of the cases.

Evaluating hatching date entirely from the standpoint of desirable characteristics that are associated with winter fecundity, these deductions seem warranted from the preceding four correlation studies: 1. That early hatched pullets are heavier in weight both at 150 days old and when they lay their first egg than are late hatched ones; 2. that late hatching tends to reduce the age at first egg; and 3. that early hatching gives greater winter egg yields, but there must be a certain optimum hatching time which gives the most uninterrupted winter egg production.

Winter Production.

The total number of birds is divided into classes of winter producers with a range of ten eggs beginning with those laying from 0 to 9 eggs and ending with those laying from 130 to 139 eggs during the winter season. Winter production is studied in its general relation to hatching date, age at first egg, weight at 150 days, weight at first egg, and daily gain in weight between 150 days old and age at first egg.

Table II

Winter Egg Production	Avg. No. of Birds	Hatching Date	Age at 1st Egg	Wt. at 150 Days—lbs.	Wt. at 1st Egg—lbs.	Daily Gain Between 150 Days Old and Age at 1st Egg—lbs.
0–9 (1)	36	7.32(M.8)	266	3.65	5.95	.021
10–19 (2)	78	6.94(M.5)	244	3.87	5.97	.024
20–29 (3)	112	7.32(M.8)	219	3.92	5.68	.025
30–39 (4)	134	7.32(M.8)	212	3.89	5.52	.027
40–49 (5)	110	7.05(M.6)	205	3.92	5.37	.026
50–59 (6)	124	6.71(M.4)	203	4.05	5.47	.027
60–69 (7)	93	5.97(A.29)	196	4.16	5.46	.029
70–79 (8)	57	5.14(A.23)	193	4.17	5.46	.029
80–89 (9)	26	4.07(A.15)	189	4.27	5.51	.032
90–99 (10)	11	4.00(A.15)	177	4.67	5.61	.040
100–109 (11)	9	2.78(A.6)	179	4.37	5.30	.029
110–119 (12)	4	2.25(A.3)	182	4.19	5.25	.032
120–129 (13)	1	5.00(A.22)	165	4.57	5.75	.057
130–139 (14)	1	2.00(A.1)	165	4.27	4.75	.032

Some degree of association exists between low production and late hatching but there is lack of consistency. A striking and consistent degree of relationship is seen in table 2 between winter egg record and age at first egg. Winter egg record and 150-day weight also show considerable dependence. There is some evidence that the low producers are heavier at first egg than the high producers. The average daily gain in weight increases as we advance down the table to the heavy winter layers. The general deduction seems warranted from table 2 that low winter egg records depend in part upon late hatching, too great an age at first egg, light 150-day weight, and slow rate of gain in body weight between 150 days old and age at first egg. In order to determine specifically how important these various relations are it is necessary to resort to the coefficient of correlation.

Age at First Egg versus Winter Production.

The degree of correlation between age at first egg and annual production in Rhode Island Reds for a period of years was found to be $-.4380 \pm .0134$ (Hays and Bennett 1923). The fact that winter egg yield is definitely ended March first while annual egg record does not terminate until 364 days after a pullet lays her first egg makes the correlation more intimate between age at first egg and winter record than between age and annual production.

The correlation coefficient between age at first egg and winter production has been calculated on 803 pullets hatched in 1923 without regard to the difference in hatching date. Constants calculated from this study follow:

Number of birds	803
Mean age at first egg	210.96
Age at first egg standard deviation	± 28.62
Mean winter production	44.46
Winter production standard deviation	± 23.04
Coefficient of correlation	$-.6061 \pm .0151$

Mean age at first egg is 210.96 days. Standard deviation of age is 28.62 which exhibits the wide range in age at first egg. The mean winter production is 44.46 eggs with a standard deviation of 23.04. Again winter fecundity shows its extreme variability as would any trait dependent upon so many hereditary factors and environmental influences.

A significant negative coefficient of correlation of $.6061 \pm .0151$ appears. Thus in six cases out of ten in these pullets hatched over a period of seventy days, there is definite association between early age at first egg and high winter egg record. In other words, the length of time that a pullet has opportunity to lay previous to March first should be given very weighty consideration in breeding for winter fecundity.

To secure an exact figure on the degree of correlation between age at first egg and winter fecundity it would be necessary to make hatching date constant by studying only those pullets hatched at the same date. Such a study, we believe, would reduce the number of individuals to such an extent that the mathematical error of calculation would be inordinately large. Below are presented the constants calculated on the 154 birds in the first three hatches. The hatching date range is thus reduced to fourteen days. Constants are as follows:

Number of birds	154
Mean age at first egg	211.58
Age at first egg standard deviation	± 39.80
Mean winter production	56.90
Winter production standard deviation	± 27.61
Coefficient of correlation	$-.6413 \pm .0320$

When the range in hatching date is reduced from 70 days to 14 days the coefficient of correlation between age at first egg and winter production increases from $-.6061 \pm .0151$ to $-.6413 \pm .0320$. This fact clearly proves that hatch-

ing date is of far less importance from the winter fecundity standpoint than is age at first egg. There are two possible reasons for this: first, early sexual maturity is associated with high winter fecundity to a greater extent than merely the time element; second, late hatching has already been shown to reduce the age at first egg.

Weight at 150 Days versus Winter Production.

In selection of pullets to put into winter quarters or in deciding upon birds to be placed in egg laying contests, the breeder desires to know just how much stress should be laid on physical characters. Weight is one characteristic that can be definitely measured. The weight at 150 days old was secured on 800 pullets that later completed winter records. The degree of correlation has been determined between weight at 150 days and winter production. Constants calculated are as follows:

Number of birds	800
Mean weight at 150 days	3.99
Weight at 150 days standard deviation	±.54
Mean winter production	44.54
Winter production standard deviation	±23.02
Coefficient of correlation	+.2758±.0220

The mean 150-day weight on the 800 pullets is 3.99 pounds with a standard deviation of .54. The mean winter production is 44.54 with a standard deviation of 23.02. Weight records show the fluctuations at the age of 150 days to be between 13 and 14 per cent.

The 800 pullets show a positive correlation coefficient amounting to .2758 ±.0220. This may be interpreted that in about one pullet out of four there is direct association between heavy weight at 150 days and a large number of winter eggs. In this particular flock, selection for heavy winter records would be about 28 per cent accurate if made on greatest 150-day weight alone.

In order to reduce the effect of hatching date on winter egg yield, studies have been made on two hatches, namely, April 15 and 22. This gives a range of but seven days in hatching date, which is practically insignificant. Constants calculated on these two hatches follow:

Number of birds	135
Mean weight at 150 days	4.16
Weight at 150 days standard deviation	±.51
Mean winter production	47.31
Winter production standard deviation	±23.93
Coefficient of correlation	+.2475±.0545

The coefficient of correlation for the two hatches does not differ significantly from that for the 800 pullets. This is evidence that hatching date had little if any effect upon the relation between 150-day weight and winter fecundity.

Weight at First Egg versus Winter Production.

The question: may the weight of a pullet in any particular variety at the time she lays her first egg be associated with high or low winter record? is of interest and importance. Should the breeder who is striving for high winter records select the heaviest pullets at first egg? These questions may be answered in general by correlating weight at first egg with winter record. Such studies have been made on 793 pullets with weight records and winter egg records. The calculated constants follow:

Number of birds	793
Mean weight at first egg	5.74
Weight at first egg standard deviation	±.73
Mean winter production	44.56
Standard deviation winter production	±23.04
Coefficient of correlation	−.1894±.0231

Mean weight at first egg is 5.74 pounds with a standard deviation of .73. The range of variability in weight is about 13 per cent and is about the same as was found at 150 days. Here is evidence that pullets weighing the most at 150 days will in general weigh the most when they lay their first egg even though there is a wide range in age at first egg.

A negative correlation coefficient of .1894±.0231 exists between weight at first egg and winter egg record. There appears to be an association between light weight at first egg and winter fecundity in about 20 per cent of the flock. The coefficient is small but significant and suggests that weight at first egg is of no very great importance in selecting for high winter record, yet there is a tendency for smaller birds to lay more winter eggs than larger birds.

By tabulating only the first eight hatches the effect of hatching date on weight is somewhat reduced. Records on 529 pullets from the first eight hatches are available for study. The constants calculated on this group are as follows:

Number of birds	529
Mean weight at first egg	5.76
Weight at first egg standard deviation	±.73
Mean winter production	47.71
Winter production standard deviation	±24.34
Coefficient of correlation	−.2963±.0269

With this group of pullets light weight at first egg is associated with high fecundity in about one case out of three. Hatching date thus appears to affect the degree of correlation.

Weight Increase versus Winter Production.

Does the rate of daily gain of pullets between the age of 150 days and the time they lay their first egg show any relationship to the number of winter eggs they will lay? Can rate of gain in the fall be considered an index to future winter production? Records are available for study on 788 pullets from which the rate of daily gain has been tabulated against number of winter eggs. The following constants appear:

Number of birds	788
Mean daily gain	.027 lb.
Daily gain standard deviation	±.00846
Mean winter production	44.59
Winter production standard deviation	±23.03
Coefficient of correlation	+.2899±.0220

This study shows the mean daily gain to be .027 pound with a standard deviation of .00846 or a range of variation in gain of about 31 per cent. The length of time over which this gain was measured varies directly with the age at first egg. Very early maturing pullets would begin laying in a comparatively few days after their 150-day weight was taken, while late maturing pullets would not begin laying until more than two months after their 150-day weight was secured. The average daily gain over a two-months' period is scarcely comparable with the average daily gain over a two-weeks' period. Yet from the standpoint of age the two are absolutely comparable in that age bears such a vital relationship to winter fecundity.

The coefficient calculated for this group is positive and amounts to .2899 ±.0220. This factor shows that in about one case out of three heavy daily gains between 150 days old and time of first egg are associated with high winter record. Heavy gainers tend to be heavy winter layers to a certain extent. In a previous section we find that the weight at 150 days is fully as reliable a guide to future winter fecundity as is rate of gain from 150 days to time of first egg.

If we eliminate the genetically late maturing birds we should expect either a higher or lower degree of correlation between weight increase and winter production than was found for the entire flock depending on whether or not the

pullets gain at a different rate shortly before laying than two months or more before they lay their first egg. The records of the 413 pullets that began to lay at 206 days or less have been tabulated to show the degree of correlation between gain in weight and winter fecundity. Constants derived are as follows:

Number of birds	413
Mean daily gain	.0292
Daily gain standard deviation	±.0090
Mean winter production	54.94
Winter production standard deviation	±21.09
Coefficient of correlation	+.2055±.0318

The mean rate of gain on this group of pullets beginning to lay at from 150 to 206 days old is slightly greater than that for the entire flock. This seems to indicate that there is a tendency for the rate of gain to increase shortly before laying. But the coefficient of correlation is .2055±.0318 as compared with a coefficient of .2899±.0220 for the entire flock. Such a difference must be interpreted as evidence that the rate of gain shortly before the first egg is a less reliable indicator of future winter fecundity than is the rate of gain over a longer period before the first egg.

Weight at 150 Days versus Age at First Egg.

In order to discover if the weight of a pullet at a particular age previous to the time she lays her first egg is an index to the probable age at which she will begin laying, the 150-day weights on 846 pullets have been tabulated with their respective ages at first egg. Constants obtained are as follows:

Number of birds	846
Mean weight at 150 days	4.02
Weight at 150 days standard deviation	±.54
Mean age at first egg	210.35
Age at first egg standard deviation	±27.74
Coefficient of correlation	−.2135±.0221

A negative coefficient amounting to .2135±.0221 was obtained. Such a constant indicates that heavy weight at 150 days is associated with early production in about one case out of five. In other words, if all other conditions were kept constant, selection on the basis of heavy weight at 150 days would be advantageous for winter production.

Weight at First Egg versus Age at First Egg.

Does body weight at first egg vary directly with age at first egg or are there other influences operating so that the element of time is not alone responsible for the weight? If the element of time were alone responsible for weight variation in any particular breed, selection for early sexual maturity would reduce body weight because sexual maturity tends to check skeletal development so that later weight accumulation is largely of adipose tissue. The degree of correlation between weight at first egg and age at first egg has been calculated on 821 pullets to discover how important a relationship does exist between weight and age. The constants obtained follow:

Number of birds	821
Mean weight at first egg	5.56
Weight at first egg standard deviation	±.69
Mean age at first egg	210.66
Age at first egg standard deviation	±28.34
Coefficient of correlation	+.4604±.0185

The coefficient of correlation here shows that about half of the large pullets owe their weight to the time element. The other half are large because they possess a different capacity for growth than the first. By developing those

influences, factors, or whatever they may be, to a maximum, the mean body weight should not diminish in an early maturing flock. On the face of it, the major problem here seems to be to discover just what these influences are and to make all conditions optimum for their manifestation.

Daily Gain versus Days Between 150 *Days Old and Age at First Egg*

The degree of importance of the time element in relation to daily gains may be ascertained from the degree of correlation between daily gain and number of days between 150-day age and age at first egg. Records on 814 pullets have been tabulated for study. The constants derived follow:

Number of birds	814
Mean daily gain	.0269
Daily gain standard deviation	$\pm .0084$
Mean days between weights	60.78
Days between weights standard deviation	± 28.12
Coefficient of correlation	$-.4145 \pm .0196$

A negative coefficient of $.4145 \pm .0196$ substantiates the opinion that pullets tend to accumulate weight very rapidly just before they begin laying. We have already shown that relative rate of gain is not of much importance in selection for winter fecundity, and that the 150-day weight is just as accurate a basis of selection as rate of gain and entails only half the labor.

Winter Production versus Annual Production.

It is important to know the degree of correlation between winter production and annual production since winter egg record may conveniently be used as a basis for selecting pullet breeders. Furthermore, winter record could be used as a basis of culling for high annual records and as a basis for determining the intensity of pullets. Annual records are not yet complete on the flock being studied, consequently the winter record of three previous flocks has been tabulated against their 365-day record. A total of 845 individuals hatched in 1920, 1921, and 1922 have been studied. Constants have been calculated as follows:

Number of birds	845
Mean winter production	70.26
Winter production standard deviation	± 25.07
Mean annual production	193.95
Annual production standard deviation	± 40.25
Coefficient of correlation	$+.6214 \pm .0142$

The above coefficient shows that in approximately six cases out of ten high winter record is directly associated with high annual record. In other words, selection for annual egg yield would be about sixty per cent accurate if made on winter trap-nest records alone. This fact makes very evident that winter egg record is of very great importance in its relation to annual record and that it is of great value in selecting pullet breeders.

In previous sections the relative importance of different measurable characteristics in relation to winter production has been discussed and the degree of correlation calculated in each case. These findings help to make clear why winter egg record as determined on a calendar basis is subject to wide variation aside from the variation caused by hereditary factors known to affect it. Such facts being known, the difficulty and uncertainty of properly classifying the pullets in distinct genotypes becomes very apparent. Such variables as have been considered must be reduced to a minimum in order to make proper matings for purposes of reducing genetic variability to a minimum. When the genetic nature of each breeding bird is discovered, definite types of matings may be made and progress assured. There can be no short road in the establishment of a flock breeding *true* for high winter fecundity.

SUMMARY

Based upon the foregoing data, the following figures show the degree of correlation between the characters stated:

1.	Between hatching date and weight at 150 days (for the entire flock)	$-.3293 \pm .0194$
2.	Between hatching date and weight at first egg	$-.3807 \pm .0201$
3.	Between hatching date and age at first egg	$-.1487 \pm .0228$
4.	Between hatching date and winter production (for the entire flock)	$-.2920 \pm .0218$
5.	Between hatching date and winter production (for the genetically early maturing birds alone)	$-.4790 \pm .0254$
6.	Between age at first egg and winter production (for the entire flock)	$-.6061 \pm .0151$
7.	Between age at first egg and winter production (first three hatches only)	$-.6413 \pm .0320$
8.	Between weight at 150 days and winter production (for the entire flock)	$+.2758 \pm .0220$
9.	Between weight at 150 days and winter production (for the hatches of April 15 and 22 only)	$+.2475 \pm .0545$
10.	Between weight at first egg and winter production (for the entire flock)	$-.1894 \pm .0231$
11.	Between weight at first egg and winter production (for the first eight hatches only)	$-.2963 \pm .0269$
12.	Between average daily gain, 150 days old to age at first egg, and winter production (for the entire flock)	$+.2899 \pm .0220$
13.	Between average daily gain, 150 days old to age at first egg, and winter production (for the genetically early maturing group alone)	$+.2055 \pm .0318$
14.	Between weight at 150 days and age at first egg	$-.2135 \pm .0221$
15.	Between weight at first egg and age at first egg	$+.4604 \pm .0185$
16.	Between average daily gain and number of days, from 150 days old to age at first egg	$-.4145 \pm .0196$
17.	Between winter and annual production, for three previous flocks	$-.6214 \pm .0142$

The most important single characteristic upon which to select pullets for winter production is age at first egg. Weight at 150 days and hatching date are of equal importance in such a selection, but of much less significance than age at first egg.

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INDEX